Volume XXV ~ Number Four Winter 19

Bell Telephone MAGAZINE

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American Telephone & Telegraph Company - New York

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Winter 1946-47

Progress in Extending Bell Rural Telephone Service, *John J. Hanselman* and *Harold S. Osborne,* 193

The Coast Guard Operates through Communications, *Admiral Joseph F. Farley,* 203

A Salute to the Spirit of Service, *Walter S. Gifford,* 224

The Growing Use of Radio in the Bell System, *Francis M. Ryan,* 225

Crisis in River Grove, *Hugh Moffett,* 238

"Hello, England": A One-way Transatlantic Talk, *William P. Banning,* 248

Opportunity, *Leroy A. Wilson,* 252

Memo to a Girl at a Switchboard, *Harold W. Stephens,* 254

Nassau—The Bell System's Conservation Specialist, *William A. Scheuch,* 256

Commercial Broadcasting Pioneer: The WEAF Experiment, 1922–1926, *A Book Review,* 267

Index to Volume XXV Available, 223

"The ideal and aim of the American Telephone and Telegraph Company and its Associated Companies is a telephone service for the nation, free, so far as humanly possible, from imperfections, errors, or delays, and enabling anyone anywhere to pick up a telephone and talk to anyone else anywhere else, clearly, quickly and at a reasonable cost."

A Medium of Suggestion & a Record of Progress

Published for the supervisory forces of the Bell System by the Information Department of AMERICAN TELEPHONE AND TELEGRAPH CO., *195 Broadway, New York 7, N. Y.*
WALTER S. GIFFORD, *Pres.;* CARROLL O. BICKELHAUPT, *Sec.;* DONALD R. BELCHER, *Treas.*

Who's Who & What's What

in This Issue

IT WAS just two years ago, in the issue of this MAGAZINE for Winter 1944–45, that JOHN J. HANSELMAN and HAROLD S. OSBORNE outlined the Bell System's plans to resume its rural telephone service program as soon as the end of the war should release the necessary men and materials. It is now about a year and a half since V-J Day, and Messrs. Hanselman and Osborne are able to give an interim progress report which sets forth an extraordinary achievement: installation of more than 400,000 rural telephones, in the face of real difficulties, during that period. Another way to say it is that the hardest two-fifths of a three-to-five-year objective of another million rural telephones has already been accomplished since the Japs cried "uncle" to Uncle Sam on the deck of the *Missouri* in Tokyo Bay.

Mr. Hanselman's Bell System career started with the Department of Operation and Engineering of the A. T. & T. Co., which he joined in 1921. In the years since, he has been successively an engineer in the rate section and a group head in several sections of the Commercial Division, sales engineer, and rate engineer. Since 1943 he has headed that Division as Assistant Vice President—Commercial. Mr. Osborne joined the A. T. & T. Co. in 1910 as an engineer in the then Transmission and Protection Department. Before becoming Chief Engineer in the O. and E. Department in 1943, he had been transmission engineer, operating results engineer, plant engineer, and assistant chief engineer.

BETWEEN MAY 10, 1909, when JOSEPH F. FARLEY was appointed a cadet in the U. S. Coast Guard, and January 1, 1946, when he was appointed Commandant with the rank of Admiral, a lot of water has gone under the keels of the vessels he has served on or commanded. Listen to the musical names of them: *Mohawk, Seminole, Onondaga, Yamacraw, Scally, Seneca, Gresham,*

John J. Hanselman

Harold S. Osborne

Admiral Joseph F. Farley

Francis M. Ryan

Hugh Moffett

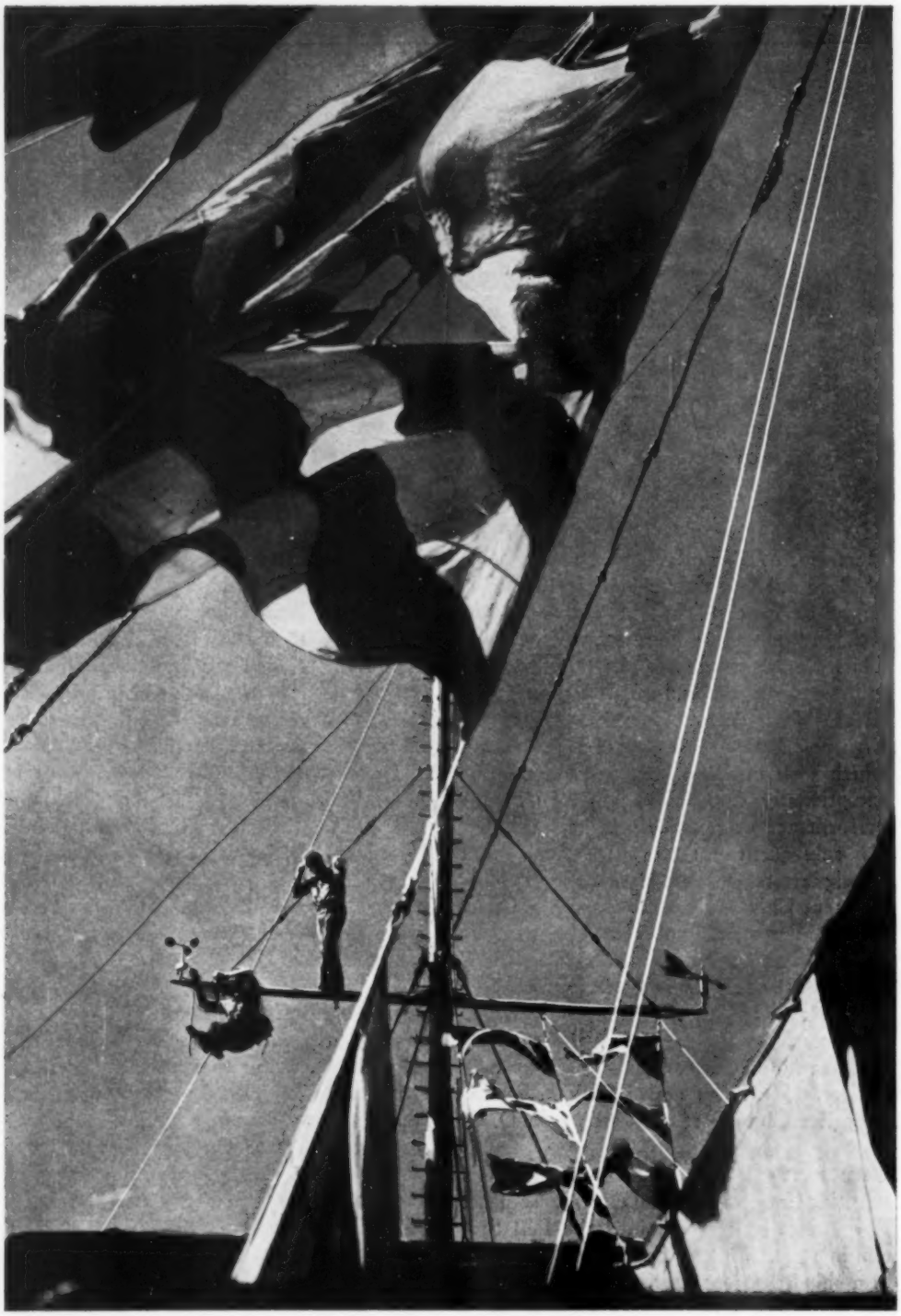
William A. Scheuch

Morrill, Mojave, McCall, Wilkes, Pontchartrain, Modoc. In between were tours of shore duty, of course—one including, as might be expected of the author of the article beginning on page 203, five years as Chief Communications Officer. That was followed by a year and a half during 1942–43 as District Coast Guard Officer of the Eighth Naval District, at New Orleans, which won him the Legion of Merit for exceptionally meritorious conduct in the performance of outstanding services. On his subsequent return to Coast Guard Headquarters in Washington, he served as Assistant Chief Operations Officer and then as Chief Personnel Officer until his appointment as Commandant. Among the organizations of which he is a member are the U. S. Naval Institute, the Society of Naval Engineers, the Society of Naval Architects and Marine Engineers, and the Newcomen Society. He is an active member of the Propeller Club, Port of Washington D. C.

THE PATTERN OF FRANCIS M. RYAN'S scientific interest was established at least seven years before he joined the Bell System in 1920. During that period he served as a ship radio operator, a radio inspector, and a college instructor in radio. From 1920 to 1936 he was a member of the technical staff of the Bell Telephone Laboratories (and its predecessor, the Engineering Department of the Western Electric Company), and again in 1942–43. From 1936 to 1942 and from 1944 to early 1946 he was Radio Engineer of the A. T. & T. Co. Since the last-named date, his title there has been Radio Coördinator. He is a Fellow of the American Institute of Electrical Engineers and of the Institute of Radio Engineers. Between the time his article was set in type and the MAGAZINE went to press, A. T. & T. announced its intent to build an experimental radio relay system, of the New York-Boston type Mr. Ryan describes, over the much greater distance between New York and Chicago—which seems to point up his reference to the *growing* use of radio.

THE INABILITY to understand how a telephone works which HUGH MOFFETT ruefully confesses may perhaps be due to an unfortunate experience he underwent as a youth, during his first visit to the metropolis of Kansas City. "They had dial phones," he writes, "everything being up to date there even at that time. I tried to call up an uncle, but failed because I was dialing all the letters of the exchange. Nobody had told me." Eleven years in newspaper work in the middle west were followed by appointment as a *Time* and *Life* correspondent in Denver in 1944 and trans-

(Continued on page 202)



Brisk wind aloft: Seamen aboard a Coast Guard ocean weather ship adjust an anemometer, so that its correct information may be incorporated in the weather reports radioed to shore every three hours. *See the article beginning on page 203*

With One-third of a Million Installations Made in Rural Areas in 1946, the Percentage of Farms with Telephones In This Country Is Greater Than Ever

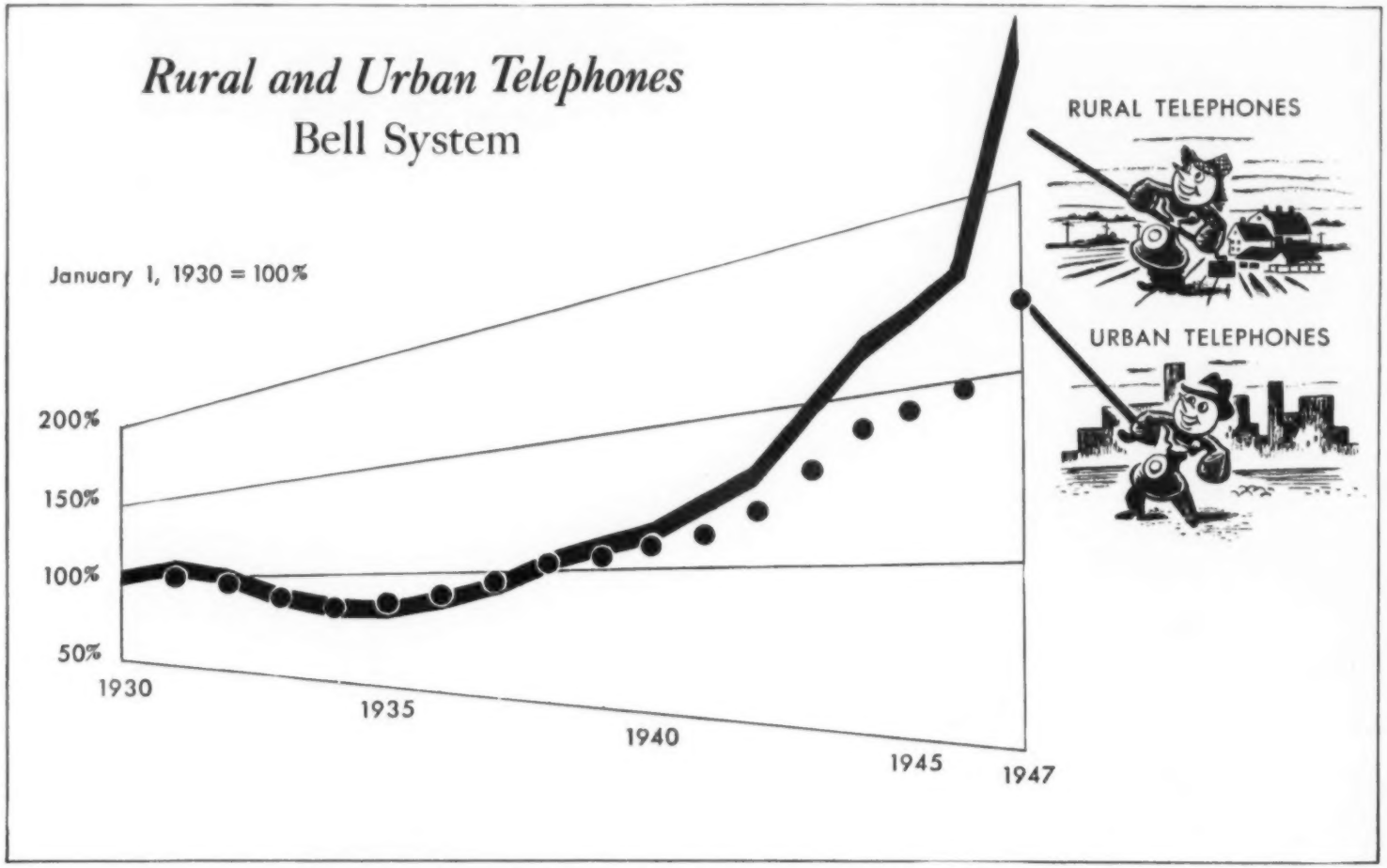
Progress in Extending Bell Rural Telephone Service

John J. Hanselman and Harold S. Osborne

IN THE YEAR JUST ENDED, the Bell System's operating companies added about 330,000 telephones in farm homes, country stores, and rural establishments of various kinds. This was more than three times the increase in rural installations ever made in any previous year in System history. Added to these are the more than 75,000 telephones installed in rural areas in 1945, bringing the total increase in rural telephone installations in two years to something more than 400,000. And last year alone, as those companies resumed their aggressive pre-war program for extending service to more and more farms,* they set nearly 300,000 telephone poles—enough to cross the continent about six times—and strung about 130,000 miles of wire.

The objective of the Bell System, as stated early in 1945, was to add another million rural telephones within three to five years after men and equipment became available. Already, in consequence of the whole industry's determined efforts, *a higher proportion of America's farms are enjoying the benefits of telephone service than ever before.* Even though war needs for telephone equipment had to come first during nearly four years of conflict, that proportion has risen from 25 percent in 1940 to the 40 percent estimated for the end of 1946.

* See "More and Better Telephone Service for Farmers," MAGAZINE, Winter 1944–45.



The increase in rural telephones in the past two years has been unprecedented

Making Good the Promise

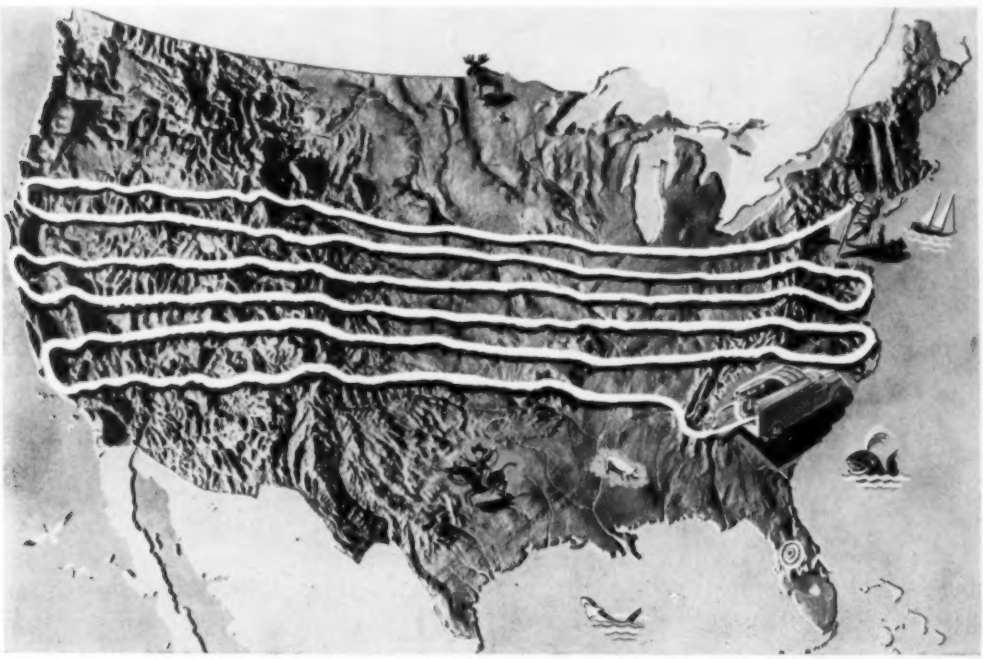
SUCH figures, impressive as they are, take on new vitality when illustrated by what the Bell System companies are bringing about in such rural areas as, for example, Springdale, Arkansas.

That locality had been served by a number of ground-return telephone lines owned by farmers thereabouts. Their lines had deteriorated, and the need for better service was urgent. The Southwestern Bell Telephone Company was asked to extend its improved facilities into the area.

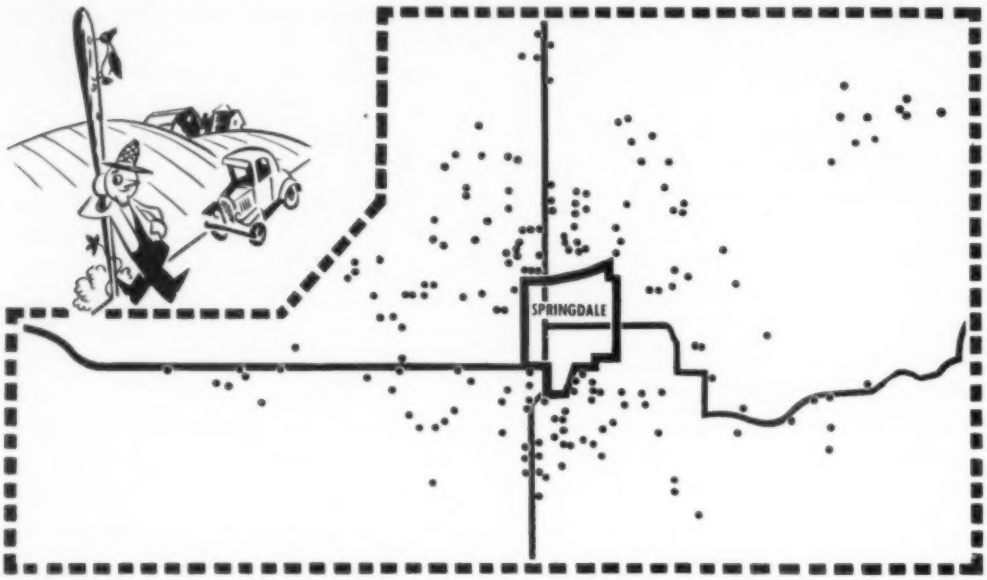
The entire area was surveyed, therefore, and plans were formulated to provide service on an area-coverage basis—as discussed more fully on a later page.

To the project were assigned a commercial representative, and an engineer with construction experience. These two, with the help of the Springdale manager on rights of way and similar matters, interviewed prospective customers and laid out the lines. In 37 working days they completed their interviews and the basic plans for building about 100 miles of new pole line and stringing more than 300 miles of open wire and 14 miles of cable to serve the area around Springdale. By the year's end, the whole job, which cost slightly more than $100,000, had been completed —and the number of customers had jumped from 196 to 517.

The diagrams on pages 196–197 portray more vividly than can those figures the results of the Bell Sys-



Enough telephone poles were set in rural areas in 1946 to carry a line across the continent about six times



The activity at Springdale, Ark., is typical of the Bell System's extension of lines to serve whole rural neighborhoods. At the beginning of 1946, telephones in the vicinity, as represented by the dots, were relatively few

tem's rural program as carried out effectively in one area—with lines extended to provide service to entire neighborhoods, so that all who apply for service can have it. Other examples of such coverage would but repeat the story.

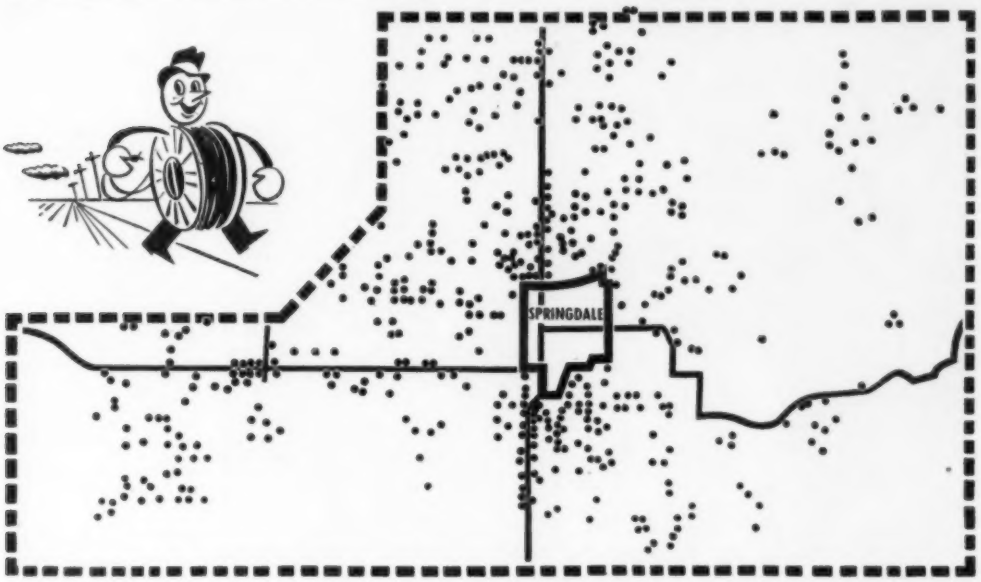
Manpower and Equipment

SUCH an undertaking as that at Springdale can go forward smoothly and productively because behind it there lies a coördinated plan.

Even before the war ended, a great deal of pertinent information was gathered together by telephone men who drove up one country road and down the next. Detailed maps showing the location of rural families along those roads were prepared, and thousands of present and potential telephone customers were asked to tell what they felt rural telephone service should include—what improvements and new features would make it more pleasing and useful to them.

On such facts as these have been built the working plans for extending and improving telephone service in rural areas. And to execute those plans promptly, specially trained forces have been added and have been assigned specifically to the rural job, under the direction of men of long experience. At each step of the way, from the planning to the final connection of the customer's service, the work is scheduled, responsibilities are assigned, and men are made available to accomplish the job.

An important feature of the System's program has been a substantial increase in the amount of new pole line which the companies will build for each new customer without



By the end of the year, as the result of a Southwestern Bell Telephone Company area-coverage project, there were two-and-a-half times as many telephones in service thereabouts

charge. Construction expense to the rural customer, therefore, has been greatly reduced and in most instances completely eliminated. Surveys made in more than 1,500 rural areas indicate that more than 80 percent of all rural families can get telephone service today without having to pay for pole line construction. The free construction allowance has been increased substantially—it is now usually half a mile per customer—and is being applied on an "area coverage" basis.

This means that where lines are being extended to serve a particular section, any unused portion of a half-mile-per-customer allowance is credited to other customers in the neighborhood who require more. For example, if 10 new customers live within four miles of an existing pole line, and 10 more live six miles farther out in the same direction, service can be extended to all 20 customers without a construction charge to any.

For customers who may still need to pay some costs for construction, the charges have generally been reduced, and most Bell companies offer a liberal plan for payment in small monthly installments over periods up to five years.

New Construction Methods

NEW METHODS and new machinery have increased considerably the practicable range of rural telephone lines.

One example of this is the use of a high-strength steel wire, developed in recent years, for building long-span pole lines and laying them out straight across private property to minimize the number of corners.

Another example is the use of a new power-driven machine for digging pole holes and placing anchors

When telephone service is planned for a rural area, the first step is to consult the people who live there. Often, as here, a Commercial representative interviews a farmer in his field about his need for a telephone

The unit consists of an earth auger driven by a gasoline engine through a flexible shaft. It is placed on a truck and the auger is raised and lowered by the truck winch line and derrick. Under favorable soil conditions, the new digger can bore holes as large as 16 inches in diameter to a depth of nine feet. Due to its lightness and flexibility of operating positions, it can be used on light-weight construction trucks instead of the heavy-duty trucks required with the older types.

Buried wire may be used in place of open wire where soil conditions are favorable and only one or two pairs will be required. The rubber-covered wire developed by the Bell Telephone Laboratories prior to the war has been improved considerably during the past year and is now undergoing field tests. It consists of a pair of 16-gauge copper conductors covered with rubber insulation, which is surrounded by a braided steel wire armor, over which is placed an outside jacket of tough, durable neoprene. Engineers are working on improvements in the truck-drawn plow which installs the wire in a furrow about two feet deep, and covers it over, in a single operation.

New Ways to Provide Service

IN ADDITION to the construction methods just described, some new rural telephones—particularly those remotely situated—are being connected by various recently devised methods. These include power-line and telephone-line carrier, "joint use," and radio-telephone.

Power-line carrier is a means of extending telephone service to farms remote from existing telephone lines but close to electric power lines. This is accomplished by using the power line simultaneously for power service and telephone service. The high-frequency telephone current "hitch-hikes" a ride along an electric power line and at a designated spot hops off

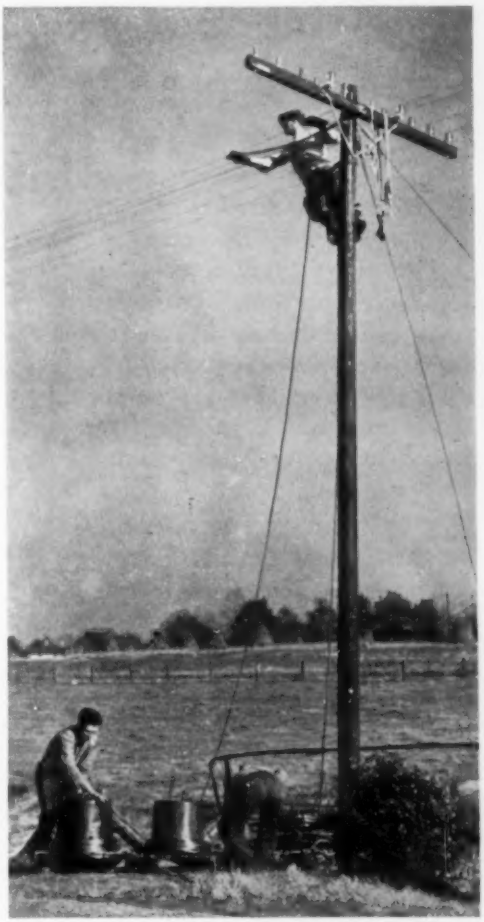
onto a pair of telephone wires running to the customer's premises.

The equipment installed in a customer's house is not greatly different in appearance from that for most ordinary telephones in use today. The electronic apparatus is encased in a box slightly larger than an ordinary bell box. Utilizing house current, its receiving vacuum tubes are energized continuously so telephone calls can be received at all times. The apparatus at the central-office end of the power line is similar in design but necessarily a little more complicated. At this writing, seven power-line carrier installations are in service in six states. Five are operated by Bell telephone companies and two by independent telephone companies over the lines of four REA coöperatives and three private power companies.

ANOTHER new but similar method of voice transmission which is expected to become increasingly important in rural areas is telephone-line carrier. Toll circuits have for some time employed carrier systems to increase the number of long distance conversations which can be carried on pole lines. Today, carrier equipment similar to that developed for power lines is being used on rural telephone lines serving Norton Mills, Vermont, on the Canadian border, where an experimental project is being conducted by engineers of the New England Telephone and Telegraph Company and the Bell Laboratories.

Another method of bringing telephone service to more rural families is the joint use of long-span power-line poles by electric and telephone companies. "Joint use," as the industry calls it, is not new. Urban distribution plants have employed joint pole-line construction for years, but it was not extensively used in rural areas. New techniques and facilities have been developed since the war and have proved satisfactory in field tests. Power and telephone organizations are arranging for their widest possible application.

One of the most important features in the development of joint use is the high-strength steel wire previ-



Then a long-span pole line is built to bring the high-strength steel wires into the neighborhood

ously mentioned, for it possesses sufficient strength to be used over the long spans commonly used on rural power lines.

Some potential telephone customers live out of reach of both existing electric power and telephone lines. This is particularly true in western United States, where there are vast stretches of ranch country. To reach these remote spots, Bell Laboratories engineers have been experimenting with radio telephony for rural telephones. Last August, engineers of the Mountain States Telephone and Telegraph Company and the Laboratories made trial installations of radio telephone equipment and other facilities at Cheyenne Wells, Colorado, which enable eight ranch families to be connected with any other telephone in the Bell System network.

The eight families live in widely separated locations, 11 to 21 miles from the Cheyenne Wells telephone central office which serves them. Four of the ranches are connected to the central office by short-wave radio; the other four are reached by comparatively short open-wire lines from one of the nearby ranches having radio telephone equipment. Thus the telephones form an eight-party line.

Transmitting and receiving equipment and other apparatus are installed at the ranch houses and the telephone central office. Calls are made and received in substantially the same way as with any ordinary telephone. Service so far has been satisfactory; and on the basis of this experience, the development of a standard system is being undertaken.

Improvements in Rural Service on the Way

PROVIDING telephone service to the waiting thousands of families in rural areas is at present, of course, the first order of business. So, although the Bell System program includes the reduction of the number of parties on rural lines to not more than eight,

Next, branch lines are brought to the farmers' homes

And finally the installer arrives with the eagerly awaited telephone

lines have been temporarily overloaded in order to give service to as many people as possible.

The program calls for not only the ultimate reduction in the number of telephones on a line, but also the replacement, whenever practicable, of the crank-type telephone by dial or other modern type of instrument.

Party-line ringing, too, is being improved. It is proposed to make arrangements so that the customer hears the rings of not more than half the parties on his line, and in many cases still further improvements can be made.

Activities to improve and modernize rural service are temporarily limited by the need to use available wire, cable, and central office equipment to extend service to new customers. Nonetheless, the objective still is to incorporate in rural service as many of the features of city service as practicable.

Service Station Lines

SERVICE-STATION LINES (also called farmer lines) are important in the rural picture. In 1946, more than 200,000 customers were served by such lines in Bell rural areas. Bell System "good neighbor" activities to advise and assist service station customers in improving the condition of their lines have been substantially expanded.

A booklet, "The Farm Telephone Manual," which tells in non-technical terms how to build service station lines and how to repair them and keep them in good working order, has been prepared and made available to all service-station organizations without charge. It has also been furnished to many independent and connecting companies.

What the Independents Are Doing

PARALLELING the Bell System's rural program is the independent telephone industry's own accelerated program to extend telephone service in their rural exchange areas. Mr. R. A. Lumpkin, President of the U. S. Independent Telephone Association, has stated that figures of the independent companies indicated a gain of about 100,000 rural telephones

for the year just ended. In an earlier statement, he had estimated that the independent telephone companies expected to spend more than $10,000,000 on rural plant construction during 1946.

What Lies Ahead?

MUCH has been accomplished in the past two years; much yet remains to be done. The pace of these activities will no doubt be accelerated. Rural construction projects exceeding those of 1946 are already fully engineered in anticipation of an increase in the supply of materials, and the Bell System's rural program moves steadily forward toward its goal of more and better telephone service for more people.

Who's Who & What's What

(Continued from page 191)

fer to Chicago in 1945 as a *Life* correspondent. Those who read the account of River Grove in the January 6 issue of *Life* will know why Mr. Moffett was asked to contribute a layman's account of the disaster there to these pages.

WHEN WILLIAM P. BANNING retired as an assistant vice president in the Information Department of the A. T. & T. Co., at the end of October in 1944, this MAGAZINE said of him, in part: "He looked upon work in the telephone business not as a job but as a profession, a service of a high degree of usefulness, rendered to the public on a high plane and, therefore, a profession of great possibilities of satisfaction to those who worked in it." That after his retirement he should choose to continue his painstaking labor on the definitive history of the establishment and early progress of Station WEAF is but another demonstration of his own continuing wish to render useful service. Those who worked with him during the preparation of "The WEAF Experiment" know the satisfaction he derived from so doing. The incident which constitutes Chapter VIII of his book is independent of any context, and so can be reprinted here for its own interest. A general estimate of the book, and a photograph of Mr. Banning, will be found on page 267.

IN THESE DAYS of crippling shortages, the salvage operations of the Nassau Smelting and Refining Company, subsidiary of Western Electric and official scrap agent for the Bell System, give a cheering example of thrift and ingenuity. Nassau's president, WILLIAM A. SCHEUCH, has devoted all his business life to metallurgy. He joined Western's research organization, the Engineering Department (later to become Bell Telephone Laboratories), in 1916. He transferred to the Hawthorne Works in Chicago in 1923; and as a member of the Engineer of Manufacture branch he served successively in positions concerned with metal research, secondary metals, heat treatment, casting, and by-products reclamation. In 1931 he came to New York as works manager of the Nassau Smelting and Refining Company's Staten Island plant, was elected vice president in 1939, and was made its president in 1946.

The Smallest of the Nation's Armed Forces Depends on Electrical Communications to Direct and Coördinate Its Many and Varied Duties and Responsibilities

The Coast Guard Operates Through Communications

Admiral Joseph F. Farley, USCG

IN TIMES OF PEACE, the Coast Guard is unique in at least two respects: its functions and its responsibilities are more diversified, and in discharging them it is more dependent upon electrical communications, than probably any other Governmental operating organization. Whether for administration of its many scattered stations, for the handling of routine activities, or for the meeting of the countless emergencies to which it is summoned, the Coast Guard depends upon its widespread communications networks for essential information about any given situation and for the transmission of directions about action to be taken.

In carrying out its varied tasks, the Coast Guard makes use of the most appropriate or effective means of speedy communication. These include principally the telephone, telegraph, teletypewriter, radio telephone, and radio telegraph.

Almost any one of the many emergency situations which the Coast Guard is called on to meet will serve to illustrate the outstandingly important function of the Service's networks of communication facilities. But because it was a recent occurrence and attracted wide attention, let us consider how communication made possible the rescue of the 18 survivors of the Sabena airliner, en route from Ireland to New York, which crashed in the Newfoundland wilds on September 18, 1946.

The plane had been in radio communication with the Gander, Newfoundland, airfield during the night, but had not come in as expected. At about 3:45 on the morning of the 18th (New York time) Gander notified the commander of the Coast Guard base at Argentia, Newfoundland, by telephone, that the plane was overdue; and likewise so notified Ste-

phenville airfield, at the other side of the great island.

Argentia immediately advised the Rescue Coördination Center located in the office of the commander of the Eastern Area headquarters of the Coast Guard. This message went by radio telegraph to the primary radio station at East Moriches, on Long Island, and thence by local teletypewriter circuit into the Area headquarters at 42 Broadway in New York City.

From here the report was also transmitted by direct teletypewriter to headquarters of the Army Communications System at Fort Totten, and to the Civil Aeronautics Administration at La Guardia Field. The Army checked immediately by A.C.S. radio teletypewriter with the landing field at Stephenville and also notified the airfield at Goose Bay, Labrador. The C.A.A. got in touch with Gander Airport through its own radio telegraph circuits.

Note that so far there has been no declared emergency: merely an *alert*. Yet within 20 minutes of the first message, airfields across Newfoundland and in Labrador had been put on notice of the obvious possibilities of *distress;* and three major agencies in this country had been notified, had made contact with their respective forces, and were keeping open the channels for the receipt of further reports.

Rescue at Gander: A survivor of the airplane crash in the Newfoundland wilds is removed from the scene in a Coast Guard helicopter

The Search Begins

WHEN the missing plane's estimated gasoline supply was reckoned to have been exhausted, it was assumed that it had made a forced landing and Coast Guard search planes stood by at Argentia base until they could take off at daylight.

Fog made the quest difficult, and the discovery of several older plane wrecks added uncertainty. By radio telephone the search pilots in their planes asked Argentia to find out the color of the missing plane; Argentia queried New York headquarters by the same circuits already described; an ordinary telephone call to the air line's office in the city brought the desired information; it was routed back to Argentia; and from Argentia to

the pilots still aloft—all in a matter of minutes.

A further complication arose from the circulation of unfounded rumors. One of these, that the plane had crashed in the sea near Newfoundland, was so persistent that New York headquarters had to radio Argentia to investigate. A Coast Guard plane was sent on an extensive flight in order to eliminate that possibility.

The wreck of the missing plane was first sighted and the existence of survivors determined about 10 o'clock that morning by a TWA transatlantic plane out of New York and making for Gander airfield. While circling the scene of the crash it summoned by radio telephone the Coast Guard detachments which were searching nearby, and these in turn notified the Gander, Argentia, and Stephenville airfields. By 10:18 a Coast Guard plane reported that it had located the wreckage and was attempting to land on a pond nearby.

This news was immediately flashed to the Coast Guard area headquarters in New York from the Coast Guard base at Argentia, to the C.A.A. at LaGuardia Field from Gander airfield, and to the Army from the Stephenville landing field—all by the communications facilities already described.

The rescue teams which made their toilsome way to the wrecked plane took "handy-talkie" radio telephones with them, and by this means kept in touch with the Coast Guard and Army planes. These in turn passed the information on to the airfields already listed, which transmitted bulletins to New York over the circuits the several Services were keeping open.

The Messages Which Brought Rescue to 18

UPON REACHING the scene on September 20, an Army doctor with the first rescue team decided that many of the survivors would be unable to withstand any overland journey. The Coast Guard's New York Area headquarters immediately undertook to provide a helicopter—the only means for expeditious yet comfortable evacuation, since it could land in a small space close to the wreck and take off again with a patient on a stretcher. The request for a helicopter reached 42 Broadway via the "handy talkie" —plane radio—radio telegraph—teletypewriter route. These three things then happened quickly:

A telephone call over a Coast Guard circuit to the Coast Guard air station at Floyd Bennett Field gave orders to dismantle a helicopter in a hurry and prepare it to be flown to Newfoundland.

An ordinary telephone call to the Army provided a four-engine transport aircraft to get the dismantled helicopter to Newfoundland—an arrangement which emphasizes the cooperation practiced by these Services.

Finally, because the Coast Guard believes in having two strings to its bow, New York area headquarters made a long distance telephone call over Bell System lines to the Coast Guard air station at Elizabeth City, N. C., where a second helicopter was taken apart, and was picked up and transported in another Army C–54.

Within 10 hours after the call for a helicopter was received in New York, the one from Floyd Bennet Field had been taken apart, packed in an Army plane, and flown to

Gander airport. There it was reassembled and flown to the wrecked plane, and picked up the first survivor and carried her out to a waiting plane on Lake Gander which would take her to the Station hospital.

The helicopter from Elizabeth City arrived two hours later.

The successful removal of all 18 survivors from the scene of the disaster by helicopter and plane is too well known to need retelling here; nor need the point be labored that the use of a variety of communications facilities coördinated the activities of several agencies, kept all informed of actions taken and progress made, left the Coast Guard base commander nearest the scene free to act quickly and effectively, and yet brought help in a hurry when it could be used.

Had the doomed plane come down at sea, much the same basic procedures would have been followed. For the Coast Guard, which for many years has made rescue its business, coördinates all activities of search and rescue—which is, after all, but a modernized version of the Coast Guard's care of all ships at sea and the men who go down to the sea in them.

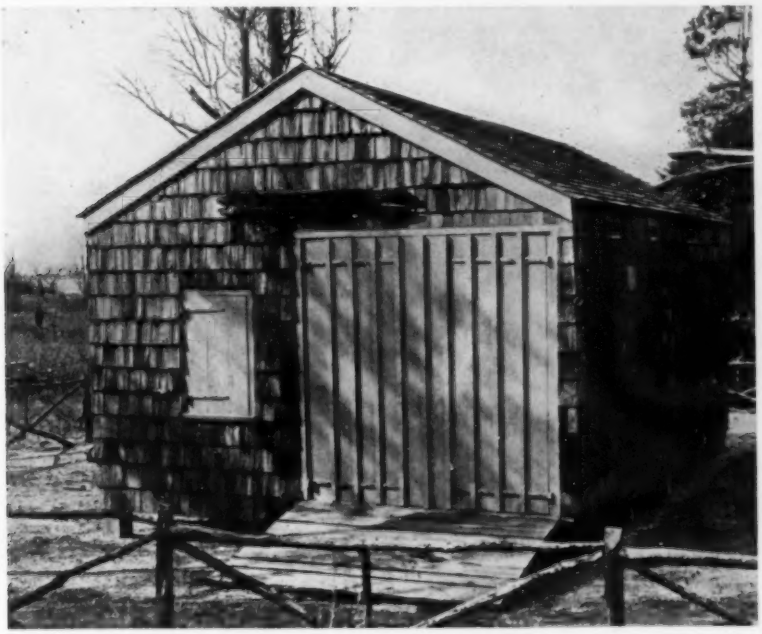
The Coast Guard a Union of Earlier Services

THE WHITE SETTLERS of this land arrived by sea, and since its earliest days the nation has been faced with maritime problems not only of shipwreck and navigation but with such others as smuggling and with questions of the standards of ship construction and operation. Separate agencies were set up to handle individual problems, but it was not long before the rapid growth of the country created an overlapping of these services.

Quite naturally then, the Coast Guard today is composed of three of these former agencies: the Revenue Cutter Service, the Life-Saving Service, and the Lighthouse Service. It has also taken over many functions of a fourth, the former Bureau of Marine Inspection and Navigation. This consolidation is quite logical, since all these agencies had jurisdiction over some portion of the government's program for the promotion of safety at sea.

TO ENFORCE the provisions of the Tariff Act of 1789, the Revenue Marine, later called the Revenue Cutter Service, was established the following year, commencing operations with ten wooden cutters. The first commission ever granted to a seagoing officer under the new Constitution went to Hopley Yeaton of New Hampshire in 1791 as "Master of a Cutter in the Service of the United States."

THE LIFE-SAVING SERVICE had its beginnings in the Massachusetts Humane Society, established in 1785 to provide relief for persons in distress on the sea as well as land. The Society built its first lifeboat station at Cohasset in 1807, but hundreds of ships were wrecked and much individual effort was expended inefficiently before Congress in 1871 saw the necessity of coördinating the administration and operation of the various life-saving activities. In that year the Life-Saving Service was set



The first lifeboat station of the original Life Saving Service—one of the forerunners of the Coast Guard

up within the Revenue Marine, but was divorced six years later to become a separate bureau under the Treasury Department.

SINCE MARITIME COMMERCE was an essential part of their lives, the Colonies themselves undertook the task of constructing their own lighthouses, buoys and other navigational aids. The first lighthouse in the country was built on Great Brewster Island at Boston in 1716. This and all eleven others erected soon after were taken over by the Federal Government in 1789. After many years under the Treasury Department, the Lighthouse Service was placed under the jurisdiction of the newly created Department of Commerce and Labor in 1903.

THE INCEPTION of the Bureau of Marine Inspection and Navigation lay in an investigation of several costly marine disasters conducted by the Treasury Department in 1824—although the first significant legislation passed was the Steamboat Act of 1852, which provided for the creation of a board of nine supervising inspectors to administer such marine safety laws as were then in effect. This board evolved into the Steamboat Inspection Service which, like the Lighthouse Service, went under the wing of the Department of Commerce and Labor in 1903.

The Coast Guard's Many Tasks

THE UNITED STATES COAST GUARD, as such, was born in 1915 with the merger of the Revenue Cutter Service and the Life-Saving Service. In 1939 the Lighthouse Service was added, and early in 1942 the Coast

Coast Guard to the rescue: R.A.F. fliers being removed from the Greenland ice cap

Guard assumed a number of the duties of the former Bureau of Marine Inspection and Navigation—a move due undoubtedly to the exigencies of war.

Through these consolidations, the Coast Guard today has many varied tasks to perform for Uncle Sam.

Its scope of activity ranges from the Bering Sea and Alaskan waters to Greenland and the North Atlantic. It includes all navigable territorial waters and seacoasts of the United States, its territories and dependencies (except the Canal Zone) together with its lakes and inland waterways. Its shore units form a coordinated network of protective and marine observation stations along the coasts of the United States, Hawaii, Alaska, Puerto Rico, and the Virgin Islands.

The normal activities of the Coast Guard are myriad. It enforces Federal laws regarding smuggling, customs, immigration, quarantine, oil pollution, navigation, and wildlife reservations, and patrols marine regattas. It eliminates navigational hazards, fights waterfront fires, provides medical and surgical aid to American deep-sea fishing vessels, carries Government representatives and mail, and it collects statistics on weather and on loss of life and property at sea. Its functions also include the suppression of mutinies aboard merchant vessels, inspection of these vessels and the licensing of their officers, the examination of merchant seamen and issuing of certificates.

Most of the Federal work requiring the use of Government vessels in the Territory of Alaska is performed by the Coast Guard. It renders medical, dental, and general welfare service to the natives there. It patrols the Bering Sea and parts of the

North Pacific Ocean. In our great river valleys, it furnishes relief to the flood-stricken. It conducts ice-breaking operations on the Great Lakes, in the Hudson River, Long Island Sound, various New England harbors and in the upper reaches of the Delaware River and Chesapeake Bay. In the North Atlantic and Pacific it maintains weather observation posts and conducts the North Atlantic International Ice Patrol, keeping the sea lanes open and reporting drifting bergs.

Integrated into the regulatory and enforcement responsibilities of the service are the humanitarian obligations of the nation. Logically, the many jobs the Coast Guard has to do provide the primary reasons for the establishment of its facilities. In time of need, these can readily be utilized in performing its emergency and assistance missions.

TO ACCOMPLISH all these tasks, enormous "plant" is required. As of 30 June 1946, the Coast Guard maintained a seagoing fleet of 269 cutters and patrol craft of all sizes, including six 327-foot, one 304-foot, seven 255-foot, three 240-foot, four 165-foot, and twelve 125-foot cutters; three ice-breakers; 14 miscellaneous types; 35 lightships; and 93 tenders. In addition, there are 166 motor lifeboats and 1229 motorboats.

On land there are aviation search and rescue facilities composed of 11 air stations and 226 aircraft: the

Convoy guardian: A Coast Guard cutter on duty in the North Atlantic against the menace of Nazi submarines

Academy at New London, Conn., for training officers; training stations at Groton, Conn., and Mayport, Fla. for the training of enlisted personnel; about 200 lifeboat stations; a shipyard at Curtis Bay, Md.; 11 repair bases; 47 depots; and two general and five district supply depots. Aids to navigation include over 500 light stations; more than 20,000 buoys; 190 radio beacons; 49 fixed LORAN (long-range navigation) stations, forming eleven chains; and 25 radio direction finder stations.

To knit together this vast, far-flung service, the Coast Guard has a communications network which binds all activities and units of the service into an efficient workable peacetime organization; yet it is so constituted that in time of national emergency it is readily integrated with the communications system of the Navy.

The Communications Network

THE LIFESAVING SERVICE (a major component of the present Coast Guard) made use of the telephone in 1878—the very first year in which telephone service was offered through commercial exchanges. The Army Signal Corps had run telegraph lines along stretches of the Atlantic Coast for its Storm Signal Service, and these had been connected with the lifesaving stations in 1876; and two years later telephones were placed on the telegraph line between Cape Henry and Kitty Hawk, so that the crews and equipment of the 12 lifesaving stations along this stretch of coast might be quickly summoned to meet a need.

This was the first use of the telephone anywhere in the world as an integral feature of a lifesaving sys-

A wartime class in radio training

tem, and it proved so effective that it was rapidly extended. Within the next decade the Signal Corps had interconnected 19 lifesaving stations on the New Jersey shore, nearly that many on the coast of North Carolina, all the stations between Cape Henlopen and Cape Charles, and several stations in the Great Lakes region. Then the newly organized Weather Bureau took over the telegraph feature of the storm warning service from the Signal Corps, and the Lifesaving Service absorbed the telephone lines.

While the telephone had thus demonstrated its value in linking the lifesaving stations along isolated stretches of coastline, it got its real start, as a system, with the program completed in 1918. This involved the expenditure of $1,200,000, which had been recommended by the Interdepartmental Board of Coastal Communications. This Board had been established by Executive Order in 1916 for the purpose of considering coastal communications with a view to improving and extending facilities for saving life and property, for the national defense, and for administration in time of war.

During this period of improvement, which involved much construction and reconstruction, the United States entered World War I, and the Coast Guard operated under the Navy. The original program was therefore considerably enlarged to meet military requirements.

It was at this time that the Coast Guard procured and laid hundreds of miles of submarine telephone cable—some of it to isolated island stations and lighthouses in the Atlantic and Pacific Oceans and the Great Lakes, which were then for the first time brought into quick communication with the mainland and the Coast Guard network. A cable testing and development laboratory near Washington, D. C., is now an important factor in designing submarine cable to meet the Service's particular requirements.

The Present Communications Network

IN THE happy interval between two wars, the telephone system, as well as other forms of communication, was further extended, until by 1940 the Communications Section was maintaining and operating several thousand miles of land wire telephone circuits and nearly a thousand miles of submarine and underground telephone cable. And there is now, for example, a continuous wire circuit—land line and submarine—extending along the Atlantic shore from the eastern end of Long Island, N. Y., to Morehead City, N. C.—a distance of approximately 700 miles.

During the war which began five years ago, this country's Atlantic and Pacific coasts were potential danger zones, and the Coast Guard's shore patrols were greatly augmented. To provide the ready communications so urgently required, hundreds of miles of rubber-covered telephone cable were purchased and were plowed in along the shore wherever conditions permitted that form of installations. Patrolmen carried telephones which they could plug into "jacks" provided at frequent intervals. Along much of the Pacific shore, the rugged terrain prevented that procedure, and there the installation of Coast Guard circuits became major construction proj-

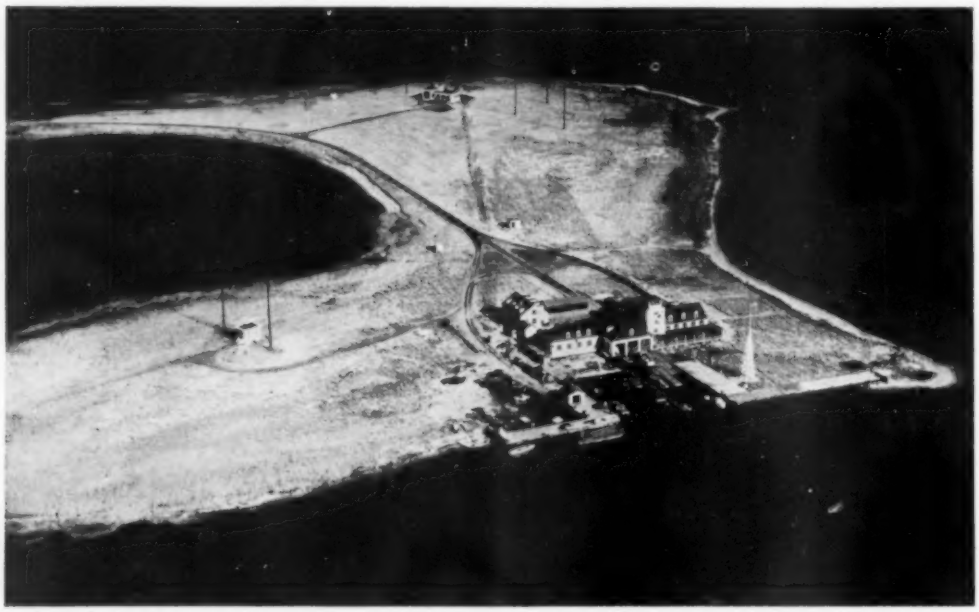
ects presenting such obstacles as mountain ranges, rock formations, and vast forests.

WHILE many of those war-time installations were of a temporary or emergency nature, the Coast Guard still owns, maintains, and operates more than 21,000 circuit miles of telephone lines—including 2,737 miles of pole line, 909 miles of submarine cable, and 218 miles of underground cable.

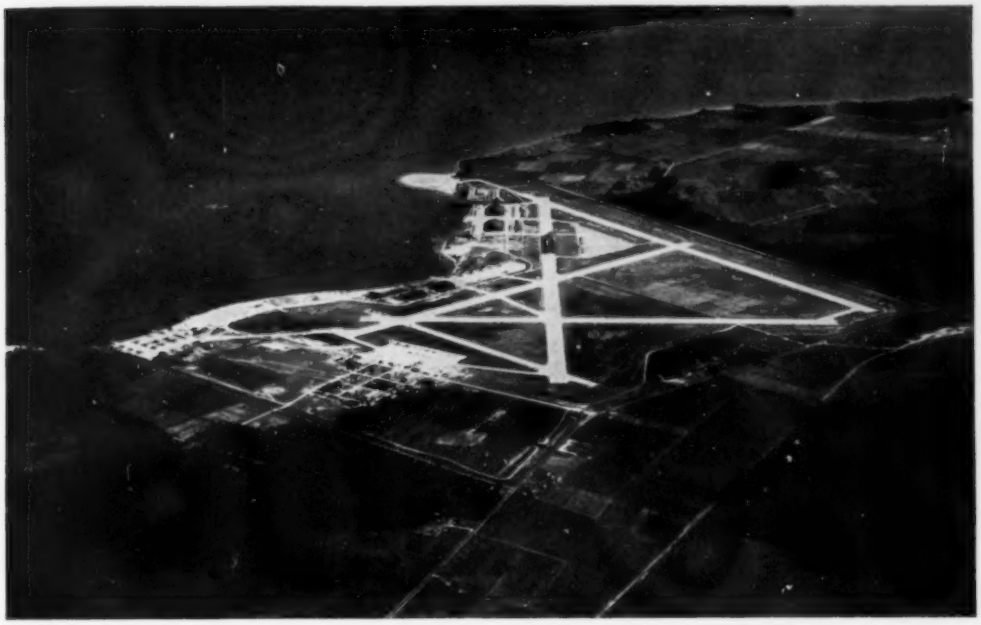
Note those three words: owns, maintains, operates. They are used here advisedly. They point to a prime example of coöperation and coordination between the Coast Guard and the country's commercial telephone companies—including, obviously, those which comprise the Bell System.

It is really quite simple. Coast Guard circuits must, in the nature of things, run to many remote and isolated places where commercial telephone companies would have no reason to construct lines. So the Coast Guard builds and maintains and operates such lines—and connects each, at some point, into the Bell System network. At some places—islands, for instance, or fishing resorts—where the Coast Guard's is the only line available, civilians may make important calls over it into the commercial central office and beyond. Where the commercial lines do run, the Coast Guard uses them—and saves itself a lot of bother.

And the Bell System, for its part, lends a helping hand or an engineering diagram or the benefit of its experience where it is needed—and provides the Coast Guard with Bell System local and long distance telephone service as required. For 30 years the two organizations have played ball



Coast Guard installations: Foreground, a lifeboat station; background, operations building, transmitter buildings, and antennas of a primary radio station



A Coast Guard air station

together, amiably and successfully, on the basis of a few ground rules and a great deal of mutual confidence and good will.

IT IS worth recalling that for the Coast Guard, as well as for others, the telephone is a two-way path—inward as well as outward. It is the public's fastest way of getting help from an organization which specializes in giving it. Every Coast Guard station is at the end of a telephone line, and no call goes unanswered.

The telephone is a great coördinator, and direct lines run between each of the fourteen Coast Guard district headquarters and various other agencies: the Army, the Navy, the Civil Aeronautics Authority, the Weather Bureau, Bell System Coastal-and-Harbor radio stations; and others which might seek or give information or assistance. At Coast Guard Headquarters in Washington, this type of direct inter-communication is in itself a complete network.

No one form of communication could meet all the needs of so widely dispersed an organization, and the Coast Guard makes extensive use of the teletypewriter. Its private lines, which it leases from the Bell System, parallel the country's continental shores, and every district headquarters has several and every major coastal unit has at least one of the chattering teletypewriters. The eastern teletypewriter network extends from Maine and Canada along the Atlantic to Key West and along the Gulf to Brownsville, Tex. On the west coast the circuits parallel the Pacific from Seattle to San Diego. Communication between the eastern and western systems is effected through the Bell System's TWX (teletypewriter exchange) service.

Plowing telephone wires into the beach for the use of Coast Guard beach patrols

While the use of the teletypewriter in emergencies is fundamental, it serves other purposes as well. It gathers and transmits data regarding the locations of ships at sea; and it transmits weather information to C.A.A. stations and to Coast Guard radio telegraph transmitting stations for the guidance of mariners, for example; and of course it carries a good deal of administrative traffic as well.

Radio telegraphy—"wireless" as it was called in its infant days during the early part of this century—has grown through the years of peace and the years of war to occupy its now preëminent place as the means of maritime communication.

The Coast Guard, then known as the U. S. Revenue Cutter Service, pioneered in the use of radio afloat when in November, 1903, the U.S.R.C. GRANT, operating in the Straits of Juan de Fuca and Puget Sound and engaged principally in the suppression of smuggling, successfully inaugurated the use of wireless telegraph for handling messages between the shore station at Port Angeles, Wash. and the GRANT. Following urgent and repeated recommendations by the Secretary of the Treasury that wireless telegraph equipment be installed on all "first class cruising cutters," Congress on 4 March, 1907, approved the sum of $30,000 for installing equipment on not to exceed 12 vessels of the U.S.R.C.S. The ALGONQUIN, in August and September of 1907, was the first of a number of cutters to be so equipped under this program. From that time on, the Coast Guard had kept constantly apace with developments and improvements, realizing clearly the value of having at its disposal the best in equipment and technique.

Two years after the ALGONQUIN installation occurred the incident which gave radio telegraphy the impetus for its universal adoption and rapid growth. Off Nantucket Island the steamships REPUBLIC and FLORIDA collided, and from the mid-

night darkness of the ocean was sent the first C Q D—the first radio call of distress. Four Coast Guard cutters in Atlantic waters intercepted that call, and a small boat from the cutter Gresham rescued the last survivors from the REPUBLIC as the ship went down. Radio had saved hundreds of lives, had introduced a new and potent factor of safety at sea. Today, no commercial vessel—practically speaking—ventures beyond sheltered waters without adequate radio equipment, and an increasing number of pleasure craft carry either radio telegraph or radio telephone installations.

It is scarcely necessary to say that Coast Guard vessels are completely equipped: the larger ones with every type of apparatus for transmitting, receiving—on many frequencies—monitoring, taking and giving bearings; even its small boats, such as motor lifeboats, have radio telephone equipment.

The other half of the Coast Guard's radio story is told in its shore installations: primary radio stations, secondary radio stations, and air radio stations, for communication principally with ships and aircraft at sea; and high-frequency direction-finder stations, the bearings from two or more of which can give a vessel's or aircraft's navigator a "fix" or position in a matter of seconds in case of actual or imminent distress.*

Building coastal telephone circuits in the Pacific Northwest sometimes involved major construction projects

Uses of Communications

SINCE communications enter into practically every Coast Guard operation, a complete discussion of communications would be tantamount to a catalog of the Service's activities. Instead, let us mention a few in which communications are of major importance.

By an agreement of long standing with the American Red Cross, the Coast Guard stands ready at all times, when called on, to assume responsibility for rescue work in inland areas beset by flood or hurricane. Routines exist for transporting men, lifesaving vessels, and other equipment—including communications

* The Coast Guard formerly furnished medium frequency radio direction finder bearings to the public for navigational purposes. This service was discontinued owing to the developed widespread use of shipborne direction-finder equipment whereby the navigator takes his own bearings on the numerous radio beacons operated by the Coast Guard at strategic points along the coasts.

Certain Communications Facilities
in Continental United States
Employed by the U. S. Coast Guard
TELETYPEWRITER CIRCUITS
PRIMARY RADIO STATIONS
SECONDARY RADIO STATIONS
DIRECTION-FINDER STATIONS

equipment—to the scene. Each district has at least one specially equipped truck which can be set up as a message center, receiving reports and information by radio directly from Coast Guard airplanes, talking with and directing Coast Guard lifesaving boats, making direct contact with the District Headquarters in case of need, and coördinating protective and rescue operations. There is close coöperation between the Coast Guard and the Bell System telephone companies in the area affected, and the record of lives saved and property safeguarded by the Coast Guard far from salt water is a proud one.

The war, and particularly the importance of aircraft, brought about many new developments in search and rescue at sea. In fact, among the duties with which the Commandant of the Coast Guard is charged as head of the Search and Rescue Agency are the coördination of research in and development of search and rescue equipment through joint studies; dissemination of information; and recommendations to appropriate agencies of the War, Navy, and other interested Departments. These responsibilities also include the maintenance of liaison with agencies of other United Nations concerned with these matters.

Such items as collapsible lifeboats, special food, clothing, and other survival equipment which may be dropped from planes, are now standard equipment on all search and rescue and on most other Coast Guard aircraft.

THE COAST GUARD communication research laboratory maintained at "Radio Washington," near Washington, D. C., has been very active in perfecting radio signaling devices for attracting rescuers. These include, among other projects, modification of the famous "Gibson Girl" emergency automatic transmitter so as to send out signals on two different frequencies, 500 kc and 8280 kc alternately, instead of only on 500 kc. The practicability as well as the greatly increased radius of reliable operation on the higher frequency was conclusively demonstrated by extensive tests under typical conditions which subsequently led to the adoption generally of the higher frequency for use by marine survival craft.

The laboratory has done much work in improving corner reflectors which are used for reflecting radar impulses sent out by searching craft and which might not otherwise detect so small an object as a rubber life raft. At the laboratory the Coast Guard is working on the development of a lightweight airborne emergency radio transmitter which could be turned on when a plane is forced to ditch and would automatically transmit its call letters, dashes, and SOS on 8280 kc to enable the high-frequency direction finder nets to determine the last position of the distressed aircraft. Other current projects include the development of an automatic alarm for use by aircraft which would place at their disposal the same means of summoning aid as now utilized by vessels.

These examples illustrate one phase of the laboratory's function: development of communications equipment, the need for which is recognized, to the point where commercial manufacturers can produce it to Coast Guard

Coast Guard communication installations. Left: Equipment at "Radio Washington," key station of the Coast Guard emergency network and in the handling of traffic for the North Atlantic Weather and Ice Patrols. Below: Teletypewriters at Eastern Area Headquarters in New York, showing at left part of the search-and-rescue plotting board

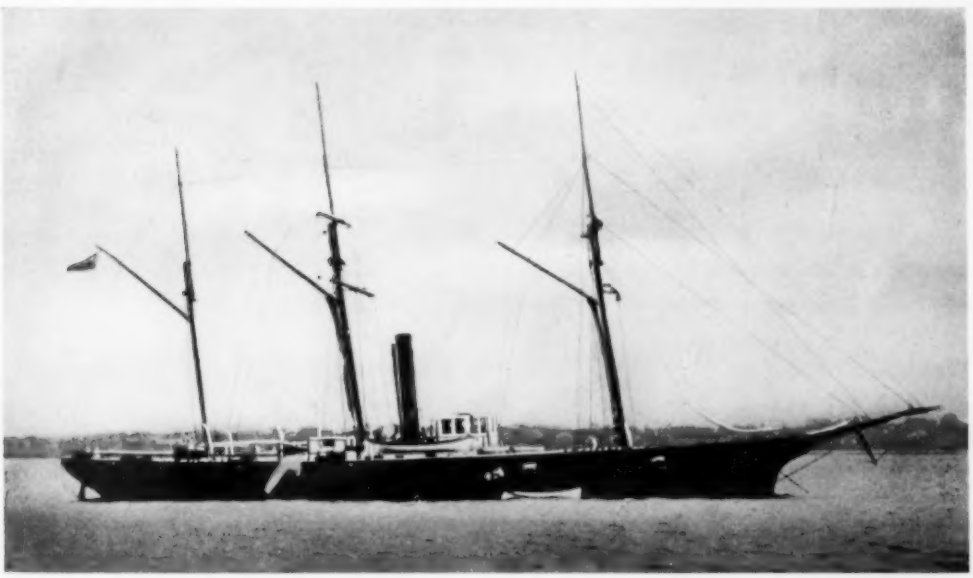
standard specifications. Equally important is its work of testing new equipment submitted to it for approval and of checking up on equipment purchased to see that it is as ordered and required by the specifications.

In addition to the work carried on by Radio Washington, the Coast Guard electronics test station at Fenwick Island, Delaware, contributes greatly to Coast Guard electronics by testing LORAN, RACON (radar beacan—aircraft), and Radio Beacon buoy equipment. This station in some measure made possible the successful use of LORAN equipment when that system was so urgently required by the armed forces during the war. The continuing need for improved electronic aids to navigation for commercial and military use indicates the important part this activity will continue to play in peacetime Coast Guard activities.

The Coast Guard Is An Armed Force

NORMALLY, the Coast Guard operates under the direction of the Treasury. But when war breaks out and the big guns start belching fire and smoke and steel in earnest, the Coast Guard immediately goes on a wartime footing under the Navy Department. The nucleus of our earliest Navy, as a matter of fact, was the Revenue Marine, whose armed ships were the backbone of this nation's defense in 1798 when war with France appeared imminent. Since then, the Coast Guard has fought side by side with the Navy in every one of this country's wars.

The war record of the Coast Guard has been portrayed in words and pictures throughout the world. Suffice it to say that certain of its peace-time activities were curtailed or suspended in World War II, while



U. S. Revenue Cutter Grant: The first vessel of the Revenue Service to be equipped with "wireless," in 1903

others were greatly expanded to meet the needs of the emergency.

Greatly augmented were the activities of port security, beach patrols, offshore patrols, ice-breaking, weather stations, search and rescue, electronic communications, navigation aids, underwater sound, and marine inspection. All seagoing cutters were assigned to convoy or anti-submarine duties. Coast Guard aircraft operated under Sea Frontier Commanders.

Total manpower rose from 25,000 officers and men at the outbreak of the war to over 170,000 by the end of the war. The establishment of the Women's Reserve, whose SPARS served in numerous communications billets ashore, aided greatly in releasing men for duty afloat, and the service was further augmented by some 65,000 temporary reservists. Many of the latter were former members of the Auxiliary, a volunteer non-military organization created in 1939 to train and instruct civilians using the high seas and navigable waters of the United States.

At the beginning of World War II, operation of the Coast Guard's communication system required some 80 officers and 1,000 enlisted men. At the peak of its wartime activities, operation of the system required over

Mobile communication equipment. Coast Guard officer (in circle) is conversing over radio telephone equipment of the type installed in the trucks shown below

700 officers and 14,000 enlisted personnel.

The Coast Guard's long experience in handling small boats, both at sea and in the breakers along our shores, was recognized as of the greatest value for amphibious operations in both the European and Pacific theaters. Today the Coast Guard is proud to be able to say that its personnel operated landing-craft in every important amphibious assault made by our armed forces during the war.

IN ADDITION to the administration of its own communications, the Coast Guard has communications responsibilities at interdepartmental and international levels.

Its Chief Communications Officer represents the Treasury Department on the Interdepartment Radio Advisory Committee; the Radio Technical Commission for Aeronautics and its Executive Committee; the Radio Propagation Executive Council; and he is alternate for the Assistant Secretary of the Treasury on the Board of War Communications and the Telecommunication Coördinating Committee. The Coast Guard is represented on the committees of the Joint and Combined Communication Boards, and on the Provisional International Civil Aviation Organization. The Chief Communications Officer served as Chairman of the U. S. Delegation to the International Meeting for Radio Aids to Marine Navigation at London in May, 1946, and he was the Treasury Department representative on the U. S. Delegation attending the Five-Power Conference convened at Moscow in October, 1946, for the purpose of

Equipment in the cable testing laboratory at "Radio Washington"

Coast Guard manned LCIs crossing the English Channel for the D-Day invasion of the coast of Normandy

preparing material for the forthcoming International Telecommunication Conference.

A Quick Look Ahead

WHILE THE COAST GUARD is readjusting itself as rapidly as possible to its post-war strength, there will be various developments affecting the scope and emphasis of its program in the post-war period.

A remarkable expansion in transoceanic air traffic is predicted. Despite the many improvements in aircraft construction and operation, this expansion is certain to be accompanied by an increased need for the search-and-rescue activities organized by the Coast Guard. This will require not only more sea and air rescue craft but improved equipment for locating and communicating with vessels and aircraft in distress. Of no little value will be further extension of the Coast Guard's research and experimental activities relating to the helicopter.

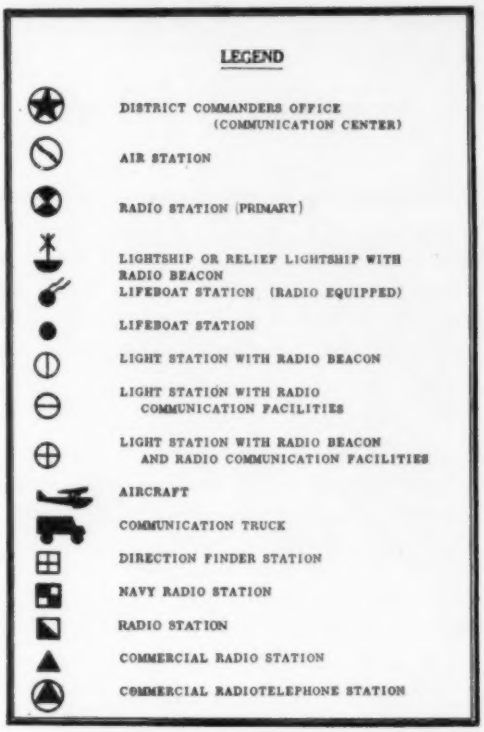
The remarkable advances made in radio and electronic devices during the war will have a profound effect upon the Coast Guard's communications and aids-to-navigation facilities and services. New research and experimental programs will be required.

Improvements of its emergency radio direction finder facilities and the re-activation of stations currently inoperative owing to the lack of personnel are among the problems which currently confront this Service.

The continued expansion of LORAN is being effected for application to peacetime ocean navigation by air and surface craft.

Improvements of facilities at its coastal radio stations and afloat, in keeping with the extended sea fron-

tiers of post-war operational requirements, are receiving their share of attention. Special study has been made to determine the post-war use to be made of RADAR by the Coast Guard, and effort has been made to help the Merchant Marine in obtaining the use of RADAR. The outcome of this study has resulted in the preparation of voluntary minimum specifications for use, if so desired, by maritime interests. These specifications have been favorably received by both operators and manufacturers. By keeping abreast of developments in the field of electronics, as well as by maintaining its traditional high standards throughout its wide-flung organization, the Coast Guard is living up to the slogan of constant preparedness which its banners so proudly bear: SEMPER PARATUS.



Symbols and legends from a Coast Guard communications chart of coastal waters indicate how large a part communications play in the activities of the Service

Index to Volume XXV Available

AN INDEX to Volume XXV (1946) of the BELL TELEPHONE MAGAZINE may be obtained upon request to the Information Department of the American Telephone and Telegraph Company, 195 Broadway, New York 7, N. Y.

A Salute to the Spirit of Service

Walter S. Gifford

Editors' note: The following is the text of the statement made by President Gifford of the A. T. & T. Company during the "Telephone Hour" radio broadcast on December 16, 1946.

A LITTLE OVER a year ago, on the Telephone Hour, I congratulated the men and women of the Bell System on the superb job they did in meeting the nation's communication needs during the war. There were 450,000 of them then and there are more than 625,000 of them now. Tonight I am sure you would all join me, if you were as familiar as I am with their extraordinary accomplishments in the face of great difficulties, in extending sincere appreciation to them for the record-breaking job they have done since V–J Day.

It is sixteen months since Japan surrendered. They have been months full of challenge to those of us in the Bell System. After nearly four years of concentrating on war, V–J Day found us seriously short of trained personnel and of equipment and facilities to meet the backed-up civilian demand for telephone service. There is perhaps less glory but certainly there is real satisfaction in peacetime accomplishments, and the accomplishments of the last sixteen months have been the most striking in the history of the System. In spite of shortages of critical materials and other difficulties beyond their control, the Bell telephone companies have installed more than twice as many telephones as they ever did before. They have added the record number of 3,800,000 telephones: almost equal to the total number of telephones in Great Britain, for example, which country ranks next to the United States in number of telephones. They have added more than seven hundred and fifty million dollars' worth of telephone equipment and facilities, and they have employed every ingenious device that could be thought of to provide the maximum amount of best possible quality of telephone service. Their slogan has been to find out how the impossible can be done and then do it. This is our American way in peacetime as well as wartime—it is the spirit that inspired the founders of our country and has made our country great.

With demands for telephone service greater than they have ever been, and with long distance calls more than three times what they were before the war, the service has been surprisingly good. But in spite of record achievements and in spite of doing our level best, we are greatly concerned that there are still over two million people waiting for telephone service and many who are not getting the kind of service they want.

The men and women of the Bell System can well take pride in what they have accomplished—but there is much yet to be done. With the spirit of service that is a tradition in the Bell System, I look forward to 1947 with high hopes that we shall make real progress in giving everyone the telephone service he wants when and as he wants it, and that we shall make real progress toward making the speed and quality of that service better than it ever was.

Radio Telephony Extends Service not only Overseas but Also to Vessels Afloat and Vehicles Ashore, and Overland to Meet Special Needs

The Growing Use of Radio in the Bell System

Francis M. Ryan

A TELEPHONE BELL rings in an automobile. The driver pulls over to the curb, takes the telephone handset from its mounting under the dash, and answers, "This is WJ6–6632." The call may bring important information, save miles of driving and hours of time, many dollars of expense.

Such calls are being made every day in many parts of the country.

Telephone service to motor vehicles is the latest addition to the many uses of radio in the Bell System. These include telephone service to ships at sea, to harbor vessels, and to airplanes, as well as overseas service connecting telephones in this country with those in the principal nations of the world.

Radio also is employed for certain domestic telephone circuits bridging water gaps or traversing difficult terrain. A recent installation of this type is a 28-mile radio circuit across the desert extending wire facilities to serve Death Valley in California. A similar circuit is being established to serve Timberline Lodge on the slopes of Mount Hood in Oregon.

The frequencies employed for these many Bell System radio services range from thousands of cycles per second, corresponding to wave lengths measured in miles, to billions of cycles per second, with wave lengths of fractions of an inch. By contrast, the dial on a standard frequency radio broadcast receiver extends from 550 kilocycles to 1600 kilocycles—a range of a little more than 1,000 kilocycles. The diagram on page 227 shows in compressed fashion (logarithmic scale) the range of frequencies employed in Bell System services compared with the standard broadcast frequency band. Without this compression, but em-

The antennas of the Death Valley terminal of the new radio telephone circuit loom over barren sands

ploying instead the scale used here to represent the broadcasting range, it would take a piece of paper 300 feet long to cover the frequency range within which Bell System services operate.

The characteristics of radio waves vary greatly with frequency. Some are suitable for one type of service, others for entirely different services. Generally speaking, waves of the lower frequencies hug the earth, while those of extremely high frequencies (micro waves) have characteristics similar to light waves. These micro waves are capable of spanning only moderate distances, as they travel in straight lines and require for their use line-of-sight conditions between transmitting and receiving stations without intervening obstructions. Over land they may be employed for longer distances by the use of relay or repeater stations along the route to be covered.

For transoceanic transmission, very low frequencies may be employed. But since sufficient numbers of such frequencies are not available to care for current needs, in-between frequencies are used which reach the other side of the ocean by bouncing down from conducting layers in the upper atmosphere which engineers call the "ionosphere."

Much of the story of research in the field of radio is of the exploration of waves of higher and higher frequencies, corresponding to shorter and shorter wave lengths. This continuing exploration has been necessary not only to provide frequency channels of suitable characteristics for the varied uses of radio, but also to provide an adequate number of channels.

Each step upward in frequency has required the development of new techniques for the generation and radiation of the waves and for their reception and utilization. As these

techniques have been developed and waves in new frequency ranges have been put to experimental use by research engineers, their characteristics and field of utility have been determined. Development engineers, following close on the heels of the research engineers, have translated these new techniques into apparatus and equipment for new kinds of telephone services.

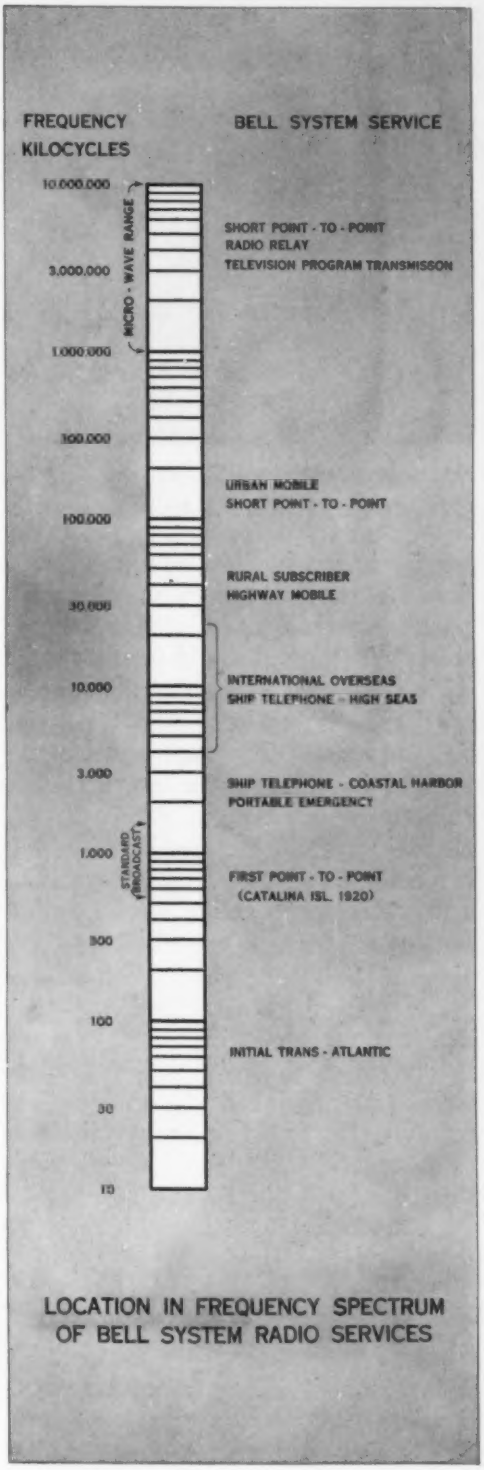
Early Experiments

THE POSSIBILITIES of radio in the field of telephony were strikingly demonstrated when in 1915 Bell System engineers transmitted the human voice for the first time across the ocean to Paris. In these experiments, frequencies of about 60,000 cycles per second, corresponding to a wave length of about three miles, were employed. To radiate waves of these great lengths effectively requires immense antenna structures, and the giant antenna of the Navy wireless telegraph station at Arlington, Virginia, towering 600 feet high, was borrowed for these experiments.

In the steady progression toward higher and higher frequencies, antennas have become smaller and smaller. For example, in a micro-wave system recently placed in service in the Bell System, the active antenna element is only 2½ inches long.

Commercial Service

THE FIRST regular day-in-and-day-out use of radio to provide telephone



LOCATION IN FREQUENCY SPECTRUM OF BELL SYSTEM RADIO SERVICES

A logarithmic representation of the radio frequency spectrum, showing to the right of the central column the location therein of various Bell System radio services. For reference, the standard broadcast band is also shown

The radio telephone station on Santa Catalina Island, established in 1920, was the first used to provide day-in-and-day-out telephone service

service began in July 1920, and was for the purpose of connecting the telephones on Santa Catalina Island, thirty miles off the California coast, with the general telephone network of the Bell System. The transmitting and receiving equipments were located in separate buildings. This radio-telephone circuit, which was in operation for more than three years, employed frequencies of about 700,000 cycles per second—700 kilocycles—corresponding to a wave length of about 1400 feet. This range of frequencies is now used for broadcasting.

These initial radio facilities were ultimately replaced by submarine cables. However, when additional telephone circuits were needed to Catalina Island in 1946, radio facilities were again installed, this time to supplement the cable facilities.

The radio facilities installed in 1946 are very different in character from those installed in 1920. The new system, which provides for eight simultaneous conversations, employs frequencies of about 4800 megacycles or nearly 5 billion cycles per second. This is a frequency 7000 times higher and corresponds to a wave length 1/7000 that of the original 1920 installation. This illustrates the vast strides that are being made in the opening of new frequency ranges and in developing the equipment, the techniques, and the "know how" necessary for their full utilization in telephone service.

Overseas Telephone Service

A VAST AMOUNT of research and development work was required before the technique of the intermittent one-way transoceanic radio-telephone experiments of 1915 was improved upon sufficiently to permit giving a reasonably reliable transatlantic telephone service. By 1927 this point was reached, and service was opened to London 20 years ago last January. For this service, frequencies in the same range (60 kilocycles) as the original overseas experiments were employed.

Shortly after this, the technique of employing higher frequencies (4,000

to 20,000 kilocycles) and shorter waves was developed. With these shorter waves, smaller antennas having directional properties became practical. The increased efficiency available through the use of these directional antennas, and the fact that these shorter waves were transmitted with relatively little attenuation, permitted the use of transmitters of more moderate power.

This technique made possible a wide extension of radio facilities for overseas telephone communication. Full advantage has been taken of it, and such facilities are now used by the Long Lines Department of the American Telephone and Telegraph Company to connect the telephone system of this country with those of the other principal nations of the world—except Canada, Mexico, and Cuba, which are reached by wire connections.

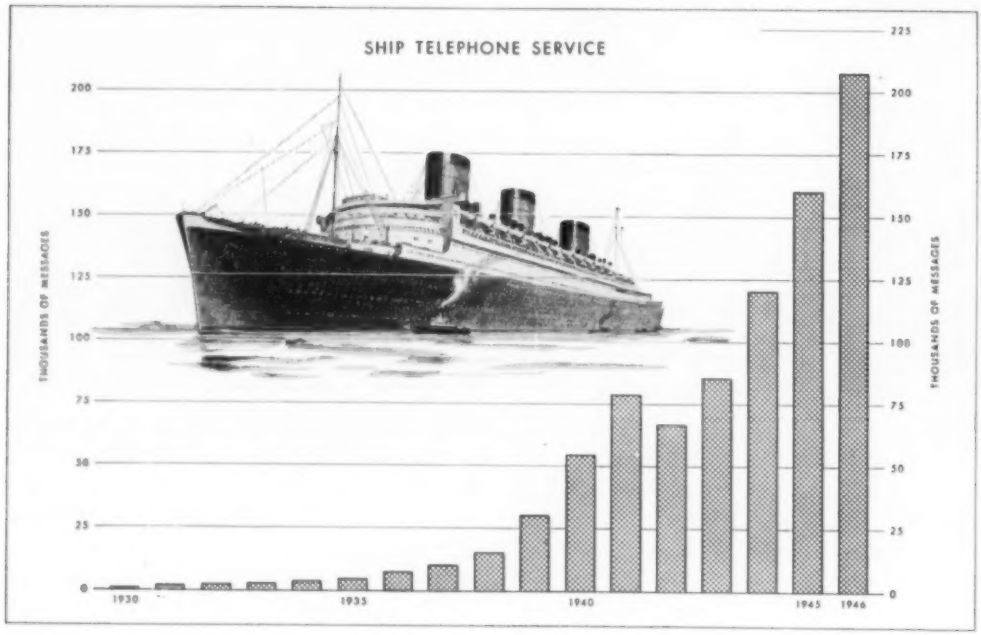
With the increased facilities available, improved techniques, and reductions in rates, the use of overseas radio-telephone circuits has grown to large proportions. At present this traffic is at an annual rate of approximately 500,000 messages.

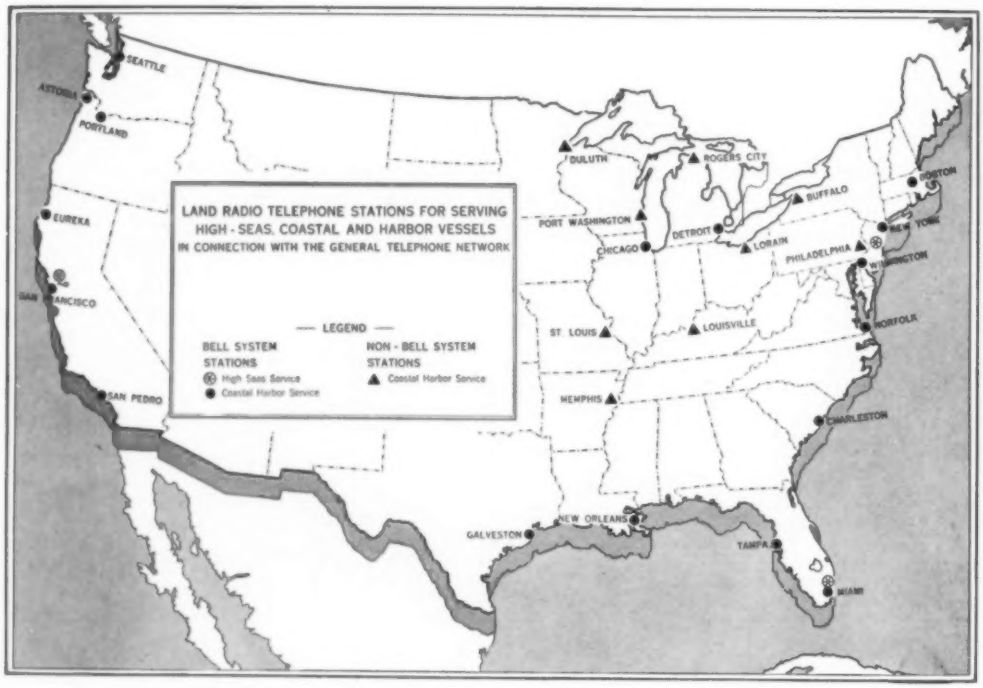
Ship Telephone Service

THE DEVELOPMENT of ship telephone service has paralleled that of overseas service. For high-seas ships the service follows the pattern of the short-wave overseas service, and employs frequencies in the same general range. The shore station equipment for this service to ocean liners is located in the same buildings as that for overseas service.

To supplement this service, facilities have been provided for serving coastal and harbor vessels. They employ frequencies of about 2,000 kilocycles. The Bell System operates

This powerful modern tug is typical of the commercial vessels using coastal-harbor telephone service


SHIP TELEPHONE SERVICE
THOUSANDS OF MESSAGES
0
25
50
75
100
125
150
175
200
225
1930
1935
1940
1945
1946


LAND RADIO TELEPHONE STATIONS FOR SERVING
HIGH-SEAS, COASTAL AND HARBOR VESSELS
IN CONNECTION WITH THE GENERAL TELEPHONE NETWORK
— LEGEND —
BELL SYSTEM STATIONS
High Seas Service
Coastal Harbor Service
NON-BELL SYSTEM STATIONS
Coastal Harbor Service
SEATTLE
ASTORIA
PORTLAND
EUREKA
SAN FRANCISCO
SAN PEDRO
DULUTH
ROGERS CITY
PORT WASHINGTON
CHICAGO
DETROIT
BUFFALO
LORAIN
PHILADELPHIA
BOSTON
NEW YORK
WILMINGTON
NORFOLK
ST. LOUIS
LOUISVILLE
MEMPHIS
CHARLESTON
GALVESTON
NEW ORLEANS
TAMPA
MIAMI

This recently completed micro-wave radio station on Cape Cod provides telephone circuits to Nantucket Island

land stations of the coastal-harbor type in 17 locations on the Atlantic seaboard, the Gulf, the Pacific coast, and the Great Lakes; and additional stations are operated by connecting companies on the Great Lakes and the Mississippi River. The location of these land radio stations employed for ship telephone service is represented on page 230. This service is used by tugs, tankers, yachts, launches, pilot boats, ferries, freighters, and ocean liners: in short, every conceivable type of marine vessel. And the service of these stations has recently been extended to aircraft on a conditional basis.

Like overseas service, ship telephone service has continued to grow. The present traffic through Bell System stations is at an annual rate of more than 200,000 messages. The number of ship telephone messages handled year by year through these stations since 1930 is indicated on page 230 also.

Domestic Point-to-Point Services

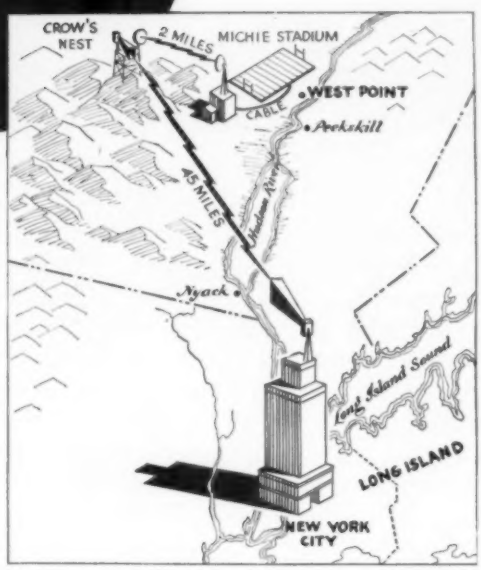
FOR COMMUNICATION with ships, radio is the only practical means. For telephone communication between fixed points on the earth's surface the situation is very different. For such cases the engineer may have the choice of using wire or radio facilities. The wire facilities may be one of many types: open wire or cable, voice frequency or carrier.* If the path crosses water, submarine cable facilities are required where wire circuits are to be used. Many factors affect the choice between radio and wire, including the quality of service attainable with presently developed techniques, the comparative costs and, in the case of radio, the availability of frequencies.

While the wire-circuit designer may feel, at least temporarily, the shortage of materials such as copper and lead, the radio engineer has seemed destined, in the design of some types of facilities, to a perpetual shortage of frequencies. For example, in the case of overseas service it is only by continually improving the techniques employed, with resultant economies in frequency use,

* See "The Messages Go Through in Many Ways," H. I. Romnes, MAGAZINE, Autumn 1945.

that the additional circuits necessary for growth are being provided. That is because this service, which depends largely on waves bounced down from the upper atmosphere, necessarily operates in the frequency band between 4,000 and 20,000 kilocycles, which is very crowded with telegraph and telephone and international broadcasting services.

At the left is a micro-wave relay station installed temporarily to transmit television images of football games at West Point via Crow's Nest to New York. The diagram below illustrates the route



In the domestic field, the situation is quite different in that advantage can be taken of the greater numbers of channels in the higher frequency ranges which have been opened up by the development of new techniques. At the higher frequencies—as already mentioned—the characteristics of the waves approach those of light, and "line-of-sight" paths must be provided for their use. While this makes them unsuitable for overseas circuits for intercontinental routes, they may nevertheless be practically employed for domestic circuits, and numerous short radio circuits employing such frequencies are in regular use in the Bell System for bridging water barriers.

The earliest one of these circuits, which bridges Cape Cod Bay, operates at a frequency of about 60 megacycles. The circuits to Catalina Island already referred to, and similar circuits from Cape Cod to Nantucket Island, are the most recently established radio facilities for domestic point-to-point service, and operate on frequencies of nearly 5,000 megacycles. The system used in these recent installations employs a pulse type of transmission not unlike that used in radar systems, the intelligence being conveyed by a unique modulation system which varies the time position of the pulses. With this system, eight conversations are handled by transmitting, in effect, a sample of each, one after another in sequence, this process being repeated over and over.

Micro-wave Systems

THE DEVELOPMENT of means of employing frequencies in the micro-wave

A micro-wave radio relay station of the New York-Boston experiment

range (frequencies above 1,000 megacycles, wave length below about one foot) has not only greatly increased the number of channels available but also made possible the use of the same channel simultaneously at stations separated by comparatively moderate distances. This becomes possible because of the limited range of transmission of such frequencies and the "searchlight" directive beams which it is possible to use when employing them. This greater directivity also enables the use of lower powers, with resultant economy.

Developments in this micro-wave range are widening the field of use of radio for domestic point-to-point communications. The Bell System has been actively engaged in developing the use of such frequencies since long before the recent war. In addition to the 8-channel micro-wave system for bridging water barriers to telephone service, another system operating in the 4,000-megacycle range is being experimentally tried out in the Bell System, with considerable success so far, for transmission of television programs from point to point. An example of the use of this system is the recent experimental transmission of television images of the football games at West Point to New York, where they were broadcast by the National Broadcasting Company. A single relay station, located on a mountain known as Crow's Nest,

An emergency radio telephone station. A pair of these compact stations can bridge a temporary gap in physical circuits to handle two-way conversations

Above: Installed on the roof of a truck cab is the equipment used in providing mobile radio telephone service

Below: A truck driver about to answer a telephone call which is reaching him through Bell System mobile radio telephone facilities

near West Point, enabled line-of-sight paths with good clearance to be employed over this 45-mile route.

Relay Systems

TELEPHONE ENGINEERS have long envisioned the employment of micro-wave radio relay systems for the transmission of bundles of telephone channels or television channels across the land in much the fashion that coaxial cables are now being employed. The attraction of such a system, with all facilities concentrated at the terminal and repeater points and no interconnecting cable or wires to install or maintain, is very great. Such a system, to be a candidate for general use, however, must meet very exacting transmission requirements, must be highly reliable, and must compare favorably in cost with wire facilities.

To assure full development of the potentialities of the radio relay type of system, a full-scale experimental installation operating in the 4,000-megacycle frequency range is being made between New York and Boston.

Seven relay stations will be located along the route. This system will be employed experimentally for television program and multiplex telephone transmission during 1947. Preliminary tests of model equipments by the Bell Telephone Laboratories, transmitting back and forth between New York and Murray Hill, N. J., have been successful and plans to install similar systems between New York and Chicago are now being made. Experience with these systems will aid in determining the future scope of radio relay systems in the long distance telephone plant of the Bell System.

Emergency Service

RADIO, operating through space without intervening conductors, appears especially suited to emergency communication in times of storm or disaster. It has, in fact, found considerable application of this sort. A hundred 50-watt portable two-way radio-telephone equipments are in the hands of Bell System operating companies, and have been used effectively to restore communication when areas have been isolated by unusual storms. These equipments operate at comparatively low frequencies (about 2,000 kilocycles) as it is not usually possible in emergencies to operate from locations which would provide the line-of-sight paths necessary for the use of very high frequencies. The power for these emergency outfits is obtained from portable gas-engine-driven generators.

Some use has also been made by the Associated Companies of radio for emergency communication with

GENERAL MOBILE TELEPHONE SERVICE - BELL SYSTEM
LAND STATIONS
● In service or Under Construction
○ F.C.C. Application Filed or Being Prepared

Spotted on this map are the locations where facilities for mobile radio telephone service are being established

motor vehicles. The New York Telephone Company has operated such a system in New York City for six years which has been used by the Consolidated Edison Company. The New England Telephone and Telegraph Company has had a similar system in operation in Boston for some time which has been used by the traction company. These systems operate in the 30–40-megacycle frequency range.

General Mobile Telephone Service

UNTIL RECENTLY, the rules of the Federal Communications Commission did not make any provision for general public telephone communication with motor vehicles. Except for police and fire-department communications, such service was limited to utilities, welfare organizations, and similar organizations, and the nature of the message was limited to that essential to the preservation of life and property.

Recently, as an outcome of its extensive hearings on frequency allocation, the Commission has allocated a few frequencies to general mobile telephone service on an experimental basis. Provision is made for two types of service, *urban* and *highway*. The urban service, which operates in the 152–162-megacycle range, is employed for service in the larger cities. The highway service, which operates in the 30–44-megacycle range, is primarily for serving vehicles on intercity routes; but it is also to be used to serve local vehicles in the smaller communities along these routes where separate urban facilities are not warranted.

The Bell System companies have been quick to make use of the newly available frequency allocations to provide telephone service to motor vehicles on an experimental basis. Facilities for urban mobile communication have already been scheduled for installation in 46 cities, in 26 of which the facilities for the first channel have already been completed. The first city to have such service was St. Louis, where the initial channel was placed in service in June 1946. Additional channels are now scheduled for installation in several cities and plans for urban facilities are under consideration in numerous others.

Urban mobile service is finding ready acceptance by the public and is already being employed by many different types of users. These include power companies, trucking companies, gas companies, burglar alarm companies, taxicab operators, motor service organizations, physicians, manufacturers, contractors, ambulance operators, armored car operators, police organizations, newspapers, railroads, and broadcasting companies. Several hundred vehicles are already using the service regularly, and the number grows daily. The service is offered to water-borne craft as well as motor vehicles, and several have already been equipped.

The facilities for urban mobile service in a city include a 250-watt radio transmitting station with its antenna located on a high building or other elevation, providing transmission throughout the area to be served—which usually reaches out 15 to 25 miles from the station—and several radio receivers located at favorable points in the area. The radio receivers and the radio transmitter are connected to the telephone switchboard by wire telephone cir-

cuits and a special terminal equipment enabling the mobile service operator to handle the circuit in very much the same fashion as other telephone circuits are handled.

Facilities for highway service are also being established rapidly in many parts of the country. One route, between Chicago and St. Louis, is now in operation. Among other routes being equipped for this service are Boston-New York-Washington, Cincinnati-Cleveland, New York-Albany-Buffalo, San Diego-Los Angeles, and several extensive routes in the southwest.

On these routes the spacings of the radio transmitting stations will vary from about 25 miles to more than 100 miles, depending on the terrain. Many of the transmitters will be of 250-watt power output, others of only 50 watts. Associated with each transmitting station will be several receivers, as in the case of urban facilities. Highway mobile radio-telephone circuits will terminate on the long distance switchboard in cities or towns along the route and in the vicinity of the transmitting stations.

The map on page 235 shows the locations throughout the country where mobile telephone service is being made available.

Rural Service

EXPERIMENTS are in progress to explore the practicability of radio for providing isolated subscribers with telephone service.* Employing modifications of the equipment which is used for mobile service, eight ranches in the vicinity of Cheyenne Wells, Colorado, are now being experimentally served by radio. Four of these ranches, ranging in distance from 11 to 21 miles from Cheyenne Wells, are reached directly by radio links; the other four are reached from one of these ranches by short wire line extensions. The operator at Cheyenne Wells makes connections with the radio subscribers in much the same manner as with other subscribers. Both local and long distance service is provided to them. This experimental installation of radio facilities for rural telephone service is giving experience which will be of value in designing radio equipment especially suited to this type of use.

RADIO has already done much to increase the scope of the telephone service of the Bell System. What further uses it may be put to cannot be predicted. However, continuing research and development assure that the full potentialities of the radio method of transmission will be available to the Associated Companies. Their active participation in the use of radio in turn assures the full development of these potentialities.

* See the article beginning on page 193.

Out of the Ashes of a Disastrous Conflagration Arose in Eleven Days a New Central Office Which Restored Service To 10,000 Silent Telephones

Crisis in River Grove

Hugh Moffett

Chicago Correspondent, Life *Magazine*

NOT LONG after a half-million-dollar fire destroyed the River Grove, Ill., telephone building, word reached the Chicago office of *Life* Magazine that an heroic task of quick restoration of service was being undertaken. A fire, even of that size, seldom is material for a national magazine. But before this fire had cooled, we learned, an army of Illinois Bell Telephone Company people, with help from other branches of the Bell System, had pitched in to give temporary emergency service to a population of some 50,000 "isolated" by the deadening of nearly 10,000 telephones. People in the River Grove area, moreover, and some of their neighbors in Chicago's west side who had been served from that building, had been promised complete service again in two weeks.

So *Life* photographer Wallace Kirkland and I went out to get a picture story.

I remember his first observation after we made a quick survey of the enterprise. We had seen a cool, determined group of traffic workers, crowded in a small business office; a crew of messengers hurrying about town delivering emergency phone calls; gangs of workers ditching, splicing cables, erecting semi-permanent Quonset huts back of the burned-out building; and doing a dozen other jobs simultaneously.

"Isn't it a pleasure," Kirkland commented, "suddenly to come across a force of people with their minds on only one thing—trying to get a job done in a hurry?"

We agreed it was a stimulating sight, and set about picking up a record of what had happened and what was happening.

First we took a look at the ruins—a two-story brick building with the roof fallen in on the valuable, hard-to-get telephone equipment. Charred chairs showed where the operators had sat—35 of them during daily

Firemen inspect the wreckage of the River Grove operating room

peaks—handling 45,000 calls a day. A few burned plugs and wires dangled from the blackened boards.

IT WAS THERE, on the morning of December 14, about 3 A.M., that operator LaVonne Daczewitz had smelled smoke. Mel Holstrom, central office maintenance man, found the basement full of smoke. The fire department arrived quickly, later was joined by Elmwood Park, Franklin Park, Maywood, and Chicago departments. But it was no use—the five operators on duty had to be ordered from the building. The clock hands showed it had been stopped at 3:20.

It had been less than an hour after LaVonne smelled smoke, we learned, that calls organizing reconstruction went out from nearby suburbs.

The night before, Friday, had been a "night out" for many employees of the Illinois Bell in Chicago. They had stayed late at a Pioneer dinner or a plant union meeting, thinking to sleep late on Saturday. But they shook off pleasant sleep and rose up to meet the emergency. By 5:30 A.M. additional lights came on in Loop offices as engineers went into action. Telephone company cars and trucks began to roll in the darkness toward River Grove.

The challenge of the crisis spread quickly to the Western Electric Company's nearby Hawthorne Works, its Kearny (N. J.) Works, and its Chicago distributing house; and to the far-away offices of the American Telephone and Telegraph Company and of Bell Telephone Laboratories. They too had to supply help and material for River Grove. Later we observed the results of these widespread efforts; but from the ruins we followed the story to what had been the site of the first reawakening of phones in the suburb a few hours after the fire—a small telephone company business office two blocks away on Grand Ave.

In this office, designed for perhaps half a dozen persons, we found at least 75. They were plying plugs, pencils, screwdrivers, and numerous other tools and pieces of equipment, some of which I still cannot identify. In newspaper days I had seen many a

crisis in the news room. The activity in that little business office approximated what would be my conception of the news coverage of election night, a kidnaping, a murder, and a flood, all rolled into one occasion. Girls worked at switchboard positions while installers were still connecting wires. Executives maintained direction while overcoated messengers scurried in and out. To one who can never understand why a telephone works anyway, it looked like multiple confusion. But we could see that it was getting results.

Establishing Emergency Service

COMPANY OFFICIALS found time to explain that a 50-pair cable led into this office. While the fire embers cooled, a two-position PBX had been located in a nearby warehouse and moved in. By about 9:30 A.M. the River Grove police and fire phones had been connected by magneto service. Before noon the first trunk lines were working off the PBX.

While these were being hooked up, Illinois Bell station wagons stood outside and mobile radio telephone units were working in them. For several hours they provided the only communications links between the on-the-ground and headquarters groups in downtown Chicago, and therefore were invaluable. Even after the first PBX lines were in, the units continued to handle part of the traffic in and out of River Grove until late in the afternoon of the first day.

Eight positions of PBX switchboard turn the telephone business office, a block from the destroyed central office, into a temporary operating room

Later, more cable and six more PBX units were added in the business office until finally a total of 286 lines were available for emergency service. Of these, more than 30 lines were for emergency outdoor public telephones. The booths were strategically located on street corners, near filling stations and other public places throughout the affected area for customers' convenience and protection.

This could take care of much of the essential business of the community, but home telephones remained silent. For them the company set up the messenger service manned by traffic and commercial people. The crises of day-to-day living continued to occur—deaths, births, accidents, empty fuel bins. A snowstorm with near-zero temperature contributed its bit to the emergency, and, incidentally, added greatly to the burden of the outside workers on day and night shifts.

As SOON as the first wires were open, all incoming calls of an emergency nature were noted and ticketed. The messengers then drove to the addresses given to pass along the information. If a return call were needed, the messenger transported the customer to the business office or to one of the outdoor "fresh air" telephone booths.

Messenger Steve LaVan knocked on the door of Mrs. Arthur Rochelle to tell her of a request that her daughter call about the death of a friend. Messenger Robert French took word to Mrs. Hoyer that the baby of her sister, Mrs. Murphy, who lives out in the country without a car, was ill and must be taken to a hospital. LaVan drove to the Westlawn cemetery to inform Manager Carl Harris that a grave must be dug.

The stork, which was flying long before there were telephone poles for it to rest on, refused to recognize the disruption in River Grove. Messengers moved with the greatest of dispatch when an incoming call said "Baby expected in short time," summoning doctor or ambulance or providing a ride. There was speculation among the messengers as to whether any might yet serve as midwife. None did.

Edward Skicewiez, Milwaukee Railroad switchman, sighed wearily as he answered a messenger's knock. He had worked long hours and now, with a dead phone, was hoping to hole up for a good rest. But the call boy and the emergency service tracked him down.

DURING the first few days after the fire, the suburban residents drove or walked to stores. The routine errands which normally slip quietly along the phone wires came alive out in the streets. This drama of visible communication reminded us of the old rural party lines, where neighbors could keep well abreast of community comings and goings. In River Grove, when Mrs. Bernadine Sendler bundled up her five-year-old and walked four blocks into the wind and over the ice, it could be easily learned that she had run out of bottled gas for cooking.

We suspected there might be some old timers about who were chuckling at youth's new-found appreciation for the telephone, which, like the kitchen sink and refrigerator, has come to be taken for granted like the sun and the

These equipment engineers at Western Electric's Kearny Works discuss their blueprints of equipment used in the burned-out central office, in order to develop quickly specifications for equipment to replace it. Four of these men later went to River Grove to put their special knowledge to work on the spot

rain. It was evident that the subscribers, with rare exceptions, were taking the temporary loss of service with great good humor and understanding. Among the exceptions was the matron who insisted that a telephone messenger direct a veterinarian to give her a telephone bulletin on the health of her ailing Pekinese, at that time housed in a pet hospital. It is not recorded just how the dog felt that day.

Organizing the Attack

AFTER our visits to the business office, where Kirkland contributed to the turmoil with light cords and flash bulbs, and some trips with the messengers, we spent part of a day at the site back of the burned building where the semi-permanent Quonset hut quarters were going up. The use of the land had been arranged before the firemen had left the scene.

In the office of an adjoining lumber yard the proprietor, S. H. Elizer, had a story to tell about the land. Feeding his little office stove with shavings and board ends against the stinging cold, he told customers how he had driven in from Memphis on the night following the fire. He was startled to see floodlights playing on his vacant lot, showing busy workmen in the early stages of erecting huts. When he learned that the telephone company had had a fire, and had been granted use of the land by his yard foreman, Walter Bell, Elizer shrugged: "That's fair enough."

In and about the Quonset huts the System-wide enterprise and dispatch were becoming apparent, along with the tireless efforts of contractors and sub-contractors. The contractors eventually numbered 25. Telephone company workers numbered about 500.

While workmen built one end of a hut, telephone equipment was unloaded in the other, finished end of it. Company officials informed us that originally a rough sketch had been drawn up, calling for a 20′ x 60′ terminal room and a 20′ x 160′ operating room. An Aurora, Ill., contractor could provide the huts. The general contractor made his plans from the rough sketch. From longhand specifications, engineers phoned orders for equipment, completely circumventing the usual typewritten order and blueprint routine.

The Western Electric Company provided cable from its Hawthorne Works at nearby Cicero. From its Kearny, N. J., plant came more cable, plus forty switchboard positions, plus cable racks and switchboard equipment which was identified for us as "multiple." Railway express cars, trucks, and five cargo planes hauled from the east the equipment which we saw converging there in the huts. And Western Electric's Chicago distributing house kept a steady stream of supplies flowing to the scene.

Planning the Reconstruction

THE OVER-ALL PLAN of reconstruction, we learned, included shifting of 2,600 phones on Lackawanna lines, which had been in the River Grove building, to the Merrimac office in Chicago. These phones served Chicago customers. But this shift required a mile of ditching, executed by a mechanical ditch digger through day, night, cold, and snow. When the ditching crew twice hit underground obstructions, the cable was

Above: A cargo plane is loaded with equipment for River Grove from Western Electric's Kearny Works. Right: More equipment is rushed aboard a truck at Western's Chicago distributing house

Equipment is going into these Quonset huts, behind the destroyed building, while the contractor's men complete the work of erecting them

laid along the surface and spliced in. Replacement of cable in conduit came later. It was a costly process, but the quickest way. In all, more than 15 miles of cable were necessary for the transfer of Lackawanna telephones to the Merrimac office.

We found a tremendous splicing operation going on in a manhole under a tent outside the old building. To permit more hands to splice in the small quarters, an excavation alongside the manhole had been made and shored up. Down we went to get a picture of Marty Quinn. He was working on one of half a dozen cables. It contained, he said, about 1400 pairs and 27 quads. Marty had to explain what quads were, and pretty soon he was talking about "phantoms." The discussion ended shortly after I told him I wanted Kirkland to get a picture of a "phantom."

In the telephone business, as in most, there appear to be some descriptive terms for workmen. I was disappointed when Marty said he should be identified only as a cable splicer. It would seem that one who can tie 1,400 pairs and 27 quads, and come out even, without a phantom left over, deserves a more romantic term.

As THE WORK progressed, we were told of construction feats and improvisations. The No. 12 switchboards, it seems, are not tailor-made for offices as large as River Grove. But this type *was* available, and certainly there was no time to manufacture another kind. So numerous modifications were called for. To avoid congestion in the crowded huts, much forming and soldering was done in a nearby garage and an out-of-service dance hall and in Western's Chicago distributing house. When soldering on the main distributing frame became a bottleneck, the soldering was postponed and the wires were twisted into place. Frame and switchboard multiple arrangements were modified to make room for extra installers and plant men.

As the days passed, the daily total of stations in service moved to three-

and then four-digit figures. Company officials who had predicted complete service in two weeks developed a fond hope as Christmas approached. The 12-hour and longer stretches by some employees began to pile up accomplishment. Many voluntarily canceled Christmas Eve plans at home.

On Christmas morning the night shift went out for a hurried breakfast, then rejoined the day shift. And so it was that at 11:30 A.M. on Christmas day the Illinois Bell Telephone Company could present to River Grove central-office subscribers an announcement of complete restoration of service—not two weeks but *eleven days* after the fire.

As the *Life* story was put together in New York a few days later, we could report the restoration. Those responsible for the reconstruction had found time to catch their breath and total up some of their efforts. There had been a half-million-dollar loss in the fire. Some $890,000 had been spent on the restoration of service, not counting the comparatively minor loss of business during the 11 days. Seven million feet of wire had been installed. There were a million hand-soldered connections—roughly, that is, in case anyone wants to count them and argue.

By the first of the year, Illinois Bell people could assure River Grove that a new, modern telephone building was on its way. Finished, it will be an attractive, reinforced concrete structure with brick and stone walls. By Christmas of this year, customers will be dialing through the new office. They have learned to expect no less, after having seen the Bell System team "going to town" in those eleven days before Christmas, 1946.

One of the "fresh air" telephone booths

Editors' Comment

MR. MOFFETT tells the story from the point of view of the outside observer. That is what we asked him to do: to write it as he saw it.

But there is another story too, which in this MAGAZINE may appropriately supplement his.

It is the story of the organization *within* the System—the integration of different units—which made it possible to undertake to perform in two weeks a task which would normally require nearly a year—and then whittle down the two weeks to 11 days.

Involved were, primarily, the Illinois Bell Telephone Company and the Western Electric Company; and, to a somewhat lesser degree, the A.

Inside one Quonset hut, installers are working on the first of three rows of switchboard positions which are being installed as fast as carpenters can lay the flooring

T. & T. Company and the Bell Telephone Laboratories. That is a good Bell System team—and a shorter word for *integration* is *teamwork*.

On that bleak Saturday morning in River Grove there were many questions waiting for answers—the *right* answers. The tougher the problem, the more important was it that the answer be the sound one.

The experience and judgment within A. T. & T.'s O. & E. Department, and the technical knowledge of the specialists at Bell Laboratories, helped Illinois Bell executives and engineers to determine the *how* and the *why* of some of the policy decisions. The *what* and the *when* answers of Western Electric, with its Chicago distributing house, two of its three Works, its Installation division, and its headquarters organization all concentrating on the emergency, tied in with the *where* which the telephone company answered on the spot. And all meshed together like matched gears.

Once more, as in many another crisis, Western Electric—the supply unit of the Bell System—demonstrated magnificently its ability to provide with breath-taking speed the equipment needed to restore service.

It may have been a fine stroke of luck that 40 sections of manual switchboard—previously earmarked for another Bell company's expansion program—were on the floor of the Merchandising division at Western's Kearny plant. But luck had nothing at all to do with Kearny's long-established file of detailed blueprints of every manual central office in the Bell System, from which those for the destroyed River Grove exchange were readily extracted. This made it possible to determine at once how best to install those 40 sections—at least for the present—and what other and how much equipment had to be replaced.

Not luck but organization and experience made it possible for some 250 of Western's central office installers to move from assignments in other places to connect those 40 new switchboard sections into the wire network—as well as an 11-position manual switchboard in Chicago's Merrimac exchange. So was it with Kearny's rush shipments of distribut-

ing frames, power equipment, and 20,000,000 conductor feet of special cable produced in 36 non-stop hours. And so it was also with the hundreds of types of miscellaneous and indispensable items of equipment supplied instantly as needed by the Hawthorne Works and the Chicago distributing house.

As these supplies flowed into River Grove, the Illinois Bell Company—which of course bore the primary responsibility—was bringing in 500 of its own men and women from assignments nearby, contracting for temporary site and shelters and for unskilled jobs, and swiftly bringing orderly progress out of that chaos which is the first consequence of disaster to a city's telephones.

Those are, in brief, some of the activities which took place behind the scenes. They, and all else which occurred during the restoration there, demonstrate strikingly the advantages of the Bell System's form of organization. For while its manufacturing, supply, and operating units are accustomed to working together to make possible the Nation's telephone service, the benefits of that complete integration show most spectacularly during emergencies such as that which beset River Grove during those cold and strenuous days toward the end of 1946.

SOMEWHERE in the Bell System there was dirty work at the crossroads—or so said a number of citizens in letters to the Federal Communications Commission during the war. They had heard transmissions of a definitely subversive nature emanating from our overseas stations on the New Jersey coast. Not only that, but the subject of these sinister messages seemed to be that supreme top secret—the Atom.

Alert interceptors had been able, for example, to pick up the following sentences:

"Magnetism is the quality which we attribute to the atom. We affirm that iron, nickel, gadolinium, gaseous oxygen, and, in fact, all substances are magnetic because they have magnetism in their atoms."

The source of this red-hot dispatch proved to be the overseas control room of the Long Lines building in New York. However, the gentlemen in this 24th floor hide-out were not engaged in nuclear fission. Their hands were unsullied by uranium.

The quotation above was merely a standard-speech recording, known for years to overseas technicians as the Juicy Atom Speech. It was used for trying out the overseas channels, and was no more than what the first line of the record described it: "This is a test transmission of the American Telephone and Telegraph Company."

From *Long Lines*, the magazine of A. T. & T. Long Lines Department

West-to-East Transmission Tests Demonstrated in 1923 The Practicability of Overseas Radio Telephony as a Commercial Undertaking

"Hello, England": A One-Way Transatlantic Talk

William P. Banning

Editors' note: The following pages, constituting Chapter VIII of Mr. Banning's recently published book, "Commercial Broadcasting Pioneer: The WEAF Experiment, 1922–1926," are reprinted here as having special interest in connection with the 20th anniversary of commercial overseas radio telephony, which occurred on January 7, 1947. See also page 267.

SINCE BELL SYSTEM CHRONOLOGY records another "radio debut" in the headquarters building a few weeks before the dedication of the new WEAF studios, this résumé of broadcasting activities will be interrupted in order to include a brief and personal reference to it. The event was historic because it demonstrated the success of telephone engineers in developing a radio technique for extending telephone service overseas.

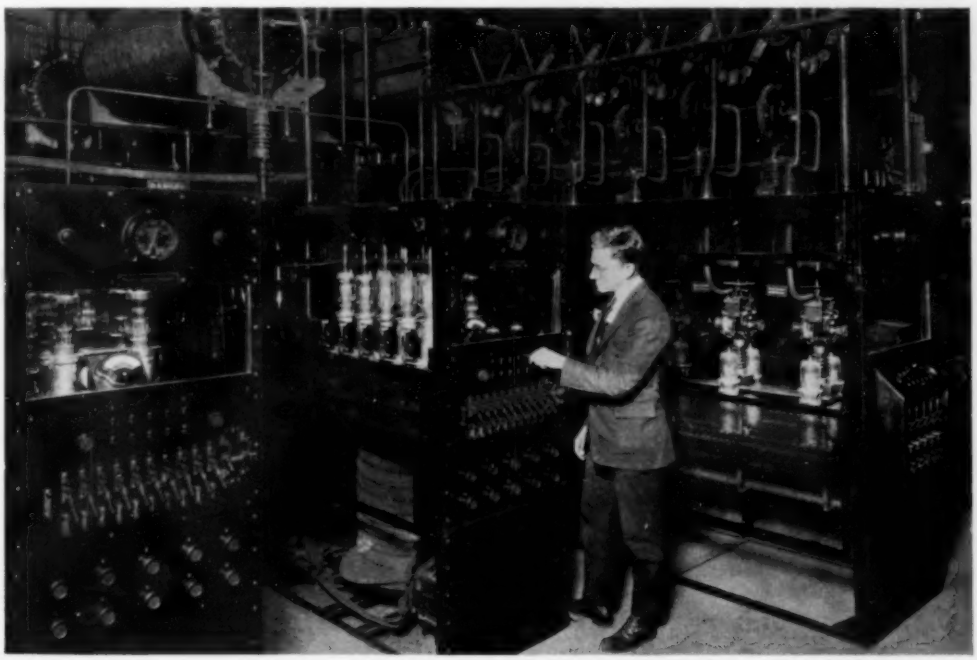
When these engineers first transmitted speech across the Atlantic in 1915, several hundred 15-watt tubes were necessary in the experiment in order to obtain sufficient power for transmission. Important research was begun after the war to develop tubes of substantial transmitting power, and a copper-anode water-cooled tube evolved which pointed the way to a solution of the problem of overseas telephony. This development work continued, and in 1922 a powerful water-cooled amplifier was installed in space leased at the R.C.A. transatlantic radio telegraph transmitting station at Rocky Point, Long Island, where an antenna was available. Telephone engineers went to England where, through the coöperation of British Post Office engineers, they were able to study and measure every variation in the transmission tests originating on Long Island. Since there was no suitable transmitting equipment on the other side of

the Atlantic, these tests could be of only west-to-east transmission.[1]

January 14, 1923, was the day selected for a demonstration of the technique which had resulted from the long and detailed experimentation, and nine o'clock in the evening was the time set, since transmission was best in the hours of darkness. The only arrangements were that President Thayer and Vice-president Gifford, and Vice-president Carty, who had technical supervision of the demonstration, would speak, and that a distinguished gathering of scientists and others would be waiting, at two o'clock in the morning, at New Southgate, near London, to hear the voices from America.

The technical importance of the demonstration has, of course, been reported in many places. Other details, of the human-interest variety, are set down in the personal notes of the present writer, who was delegated to inform the press of the event and who was on hand during the day to observe the preparation. These notes refer, for example, to the D&R engineers who equalized and provided amplifiers for the wire lines connecting the headquarters building with the Rocky Point apparatus. They picture the afternoon scene in President Thayer's office where engineers sat before a special transmitter, reading aloud newspaper items or long

[1] The group of engineers in charge of the Rocky Point installation was headed by Mr. A. A. Oswald. Those who carried on the transmission tests in England were Dr. H. W. Nichols and Mr. H. T. Friis. Later in the year Dr. Nichols was awarded the Fahie Premium by the Institution of Electrical Engineers in London for a lecture before the Institution on Transatlantic Wireless Telephony.



Transmitting equipment for transatlantic radio telephony, installed at Rocky Point in 1923 by telephone engineers. The picture shows the water-cooled tubes referred to in the second paragraph of the narrative

President Harry B. Thayer of the American Telephone and Telegraph Company speaking in a one-way radio telephone test to England, January 14, 1923

lists of words, while cablegrams arrived at intervals from London reporting "60% intelligible," then "70% intelligible"— then "80% intelligible"—the percentage climbing higher as daylight faded.

In the notebook also is the record of a conversation in the office of Vice-president Carty, who had remarked about six o'clock, after giving some final instructions, "Now I'll get a little nap." "What!" said this astonished publicity manager, "Aren't you nervous? Can you really sleep?" "There's nothing to worry about," was the answer. "The tests are what I expected. There was sleet on the wires just before we opened the first transcontinental line, but I slept, on that very sofa, for 30 minutes. You see, I knew that line was being watched—by telephone men."

And besides such random jottings, the notebook also records historic messages, together with an incident which, though inconsequential, still stands out in the writer's memory. Before nine o'clock arrived there were many reassuring messages "100% intelligible," and promptly on the hour Mr. Thayer laid aside his cigar and began to read the words addressed to an audience 3,000 miles away on another continent.

Eleven minutes later came the cabled message:

"Thayer got through to all." Signed, GILL [2]

As the tests proceeded, other cablegrams arrived in thrilling sequence:

To General Carty at 9:14 P.M. Purves [3] recognized Carty. Signed, GILL

To General Carty at 9:21 P.M. Audience wants some local color. Going fine. Press wants pause between speakers and clear announcements of names. GILL

To General Carty at 9:26 P.M. A few listeners have trouble with the American language. General impression fine as far as we can judge during intermission. Signed, GILL

To General Carty at 9:35 P.M. I have listened with great interest and pleasure to the far-flung voices of Mr. Thayer and Mr. Carty. Of Mr. Thayer's message, I recog-

[2] Mr. Frank Gill, Chief European Engineer of the International Western Electric Company and also President of the British Institution of Electrical Engineers, who was in charge of technical arrangements in England.

[3] Engineer-in-Chief of the General Post Office of Great Britain.

nized every word. I missed a little of Mr. Carty's but recognized absolutely his well-known intonations. Send best respects and warmest good wishes to our friends in the A. T. & T. and W. E. Co. Signed, PURVES

To General Carty at 9:36 P.M. For Mr. Thayer. I heard every word you said and recognized your voice perfectly. Signed, WILKINS [4]

To General Carty at 10:01 P.M. Representatives of British press congratulate A. T. & T. Co. and Radio Corp.[5] on their epoch-making experiment, the success of which has exceeded their expectations, and in which they see the dawning of a new era in long distance speaking which will be of the greatest value to the press of the world.
PRESS REPRESENTATIVES

To President Thayer at 10:10 P.M. I have just listened to your radio telephonic message which I have heard very distinctly. I congratulate you and all those connected with the research which has led to this achievement. G. MARCONI

To General Carty at 10:45 P.M. To your engineers the most sincere fraternal greetings from their British confreres. Signed, GILL

To General Carty at 10:58 P.M. On conclusion of these most successful and historic tests which have made a profound impression, all those assembled at the London end wish to congratulate most heartily the A. T. and T. Co. Signed, GILL

To President Thayer at 10:58 P.M. Heartiest congratulations on what has been achieved and on the complete success of its demonstration. Your voice was just like a personal talk. Would not have missed it for world. Signed, KINGSBURY [6]

To General Carty at 10:58 P.M. Loud speaker now being used. Good results. Great enthusiasm. Signed, GILL

To General Carty at 11:00 P.M. Your interview on loud speaker came through fine. Signed, GILL

To General Carty at 11:01 P.M. There is only one word—magnificent. GILL

With communications history thus being made every moment, the press representatives were invited to come downtown for the news. Yet when they arrived, there was little to give them but a technical explanation of the test and copies of the congratulatory messages as they arrived.

This chronicler sensed that the newspaper men did not fully realize the import of the occasion and reported with disappointment to Vice-president Gifford that they seemed unimpressed. "I know what's the matter," said Mr. Gifford, "they want evidence! General Carty has that door closed to keep out noise, but I'm going to open it so these men can see what's going on!" And, beckoning to the skeptical reporters, he opened the door to the President's office, disclosing a smiling man with a sheaf of telegrams in his hand, speaking into a strange-looking transmitter. "That's Mr. Thayer, gentlemen," said Mr. Gifford, quietly, "and he's talking to England!"

And so, among the memories of an eventful evening, is that unplanned, informal scene—a prideful president saying for his colleagues, "Thanks for your message," and a group of newspaper men clustered at his door, listening intently, and almost unbelievingly, to words that were flashing across the sea, heralds of a service to reach all parts of the globe.

[4] Mr. F. H. Wilkins, Vice-president and European General Manager, International Western Electric Company.

[5] The American Company had announced the experiment as "coöperative" because of contractual relations with RCA and because of the use of certain large RCA antennas on Long Island.

[6] J. E. Kingsbury, author of *The Telephone and Telephone Exchanges* (London, 1915) and a director of Western Electric, Ltd. of London.

Opportunity

Leroy A. Wilson

Editors' note: The following excerpts are from an address by Vice President Wilson of the A. T. & T. Company at a special convocation of honorary societies at Denison University.

OPPORTUNITY must be taken hold of, cultivated and made to bear fruit. The responsibility is yours to accept this challenge and to meet it effectively.

By effectively, I mean for the benefit of society. There have been over the ages, many examples of men banding together for the common good. Too often, however, there have also been leaders who have used their ability and their following for selfish ends with insufficient regard for the rights and welfare of others. We all know well that that is not the kind of leadership which the Christian concept asks us to assume. Neither is it the kind which will enable us to maintain our national heritage of freedom.

In the years ahead, the roads we shall follow will be the roads that we build, and they will lead where we want them to take us. Where do we want to go? In the direction of a free, vigorous and healthy national life—with plenty of room for enterprise and for individual development of character and judgment limited only by a proper regard for the rights of others and a solid respect for the virtues of competitors? Or do we want to move toward a narrower life in which freedom of action is sacrificed, in which individual character and judgment is subordinated for uncertain assurance of physical security for clothing, food and shelter, but little else; in which man becomes the servant of a system rather than the master of his own affairs?

*

None of us, of course, is unaware that there are discords within this land of ours today. Much of it is expressed in intemperate, even belligerent language. And we have our prophets of doom. In my judgment, however, we have too solid a basis for faith in our heritage and in our way of life to allow ourselves to be dismayed by any problem that confronts us.

Just consider our economic position alone, in contrast with that of most of the rest of the world. In our system of free private enterprise, we find the greatest hope for the greatest well being of the greatest number of people. American industry and labor have performed as no others have yet been able to do. The American worker commands the highest pay and has the highest standard of living in the world. He is free to live, to move around, to worship, to express himself, and to earn a living in a vocation of his own choice. Equally important is his opportunity to rise from the ranks to the top of his vocation. Most of our leaders in industry, in science, in the professions and in public life—in fact, in all phases of the constructive work that has made this nation great—have come up through the ranks. Their lives bear testimony to the opportunity which is presented to

every American boy and girl. There is no ceiling on your opportunity; there is only the limitation which your own ability places upon it.

All these things mean that we have something that exists in the United States of America to a degree that has never been reached before anywhere. We have attained it under our American system of democratic government and free enterprise which in turn has sprung from the initiative, the spirit of fair play and the common sense of all the people. That being so, it behooves us all to preserve the vitality of that system—to contribute toward it for the greater good of all—and to face the future with confidence.

This country, its people and enterprises, this University, have come to their splendid position out of the rugged endeavors of pioneers—early pioneers and modern ones still pioneering. Free men and women in a free land seized their opportunities and brought miracles to pass, spurred on by the belief that all men are created equal and entitled to life, liberty and the pursuit of happiness. They were determined to achieve those things—for themselves, their families and their fellow countrymen—and they have done so. That determination should never be surrendered.

Success is often attributed to such qualities as knowledge, judgment, energy, patience, imagination, and so on. These are all excellent qualities, but I doubt that by themselves they give the real answer. For years this question of what constitutes success has intrigued me personally, and I have tried to arrive at my own definition. To me, success depends on two simple things—first, the ability of the individual to analyze a situation and decide what should be done, and second, his or her capacity and courage to get it done. To say it even more simply, if you can learn to know what you are fitted to do, and then do it well, then surely your life will be a success.

Under this way of thinking, your success will not be measured by any particular achievement, or by your place in the social scale, or by the rank attached to your job. Rather, it will be measured by your own inner feeling when you ask yourself, "Have I made full and able use of head, heart and hand in the thinking, the understanding of others and the action that could reasonably have been expected of me?"

Opportunity, in capital letters, beckons you in a greater degree than ever before to exercise the kind of leadership that will help this nation along its fortunate and happy way.

Memo To a Girl at a Switchboard

Harold W. Stephens

WHERE WERE YOU *when Christmas came, Miss Susie-at-the-Switchboard?*

Where were you when the bells rang in the New Year?

Where, through the holidays in between?

I asked your friends who saw you.

One saw you on the streets, part of the merry Christmas and New Year throngs.

One, paying a round of holiday calls, your arms laden with gifts.

Another saw you at church.

Still another saw you out with a fellow with broad shoulders, who reached for your hand as the two of you walked along.

What they saw was as it should be, Susie.

That's what's done at Christmas and New Year's today, and you're of today, every vivid inch of you.

You're alert and modern, in step with this new year of 1947.

But, tell me, did your friends see everything?

A doctor told me they didn't.

He made a call on Christmas Day.

It was an important call, for a life hung in the balance.

A stranger said they didn't.

He was hundreds of miles from home, and lonely with the holiday happiness about him, but through the telephone he paid a visit home.

And even as the bells tolled in the New Year, someone who needed help reached for the telephone.

Someone handled those calls, Susie, and thousands more like them.

Shall I ask you who?

YOU'RE STRICTLY 1947, *Miss Susie.*

A bright path and ready laughter are your heritage and your right.

But you are also wise beyond your years, for you know that these things are not all.

DID YOU KNOW, *Miss Susie-at-the-Switchboard, that a picture of you was painted, back years ago before you were born?*

That's true—and more than any other picture ever painted, it has captured the significance of telephone communication for all time and all people.

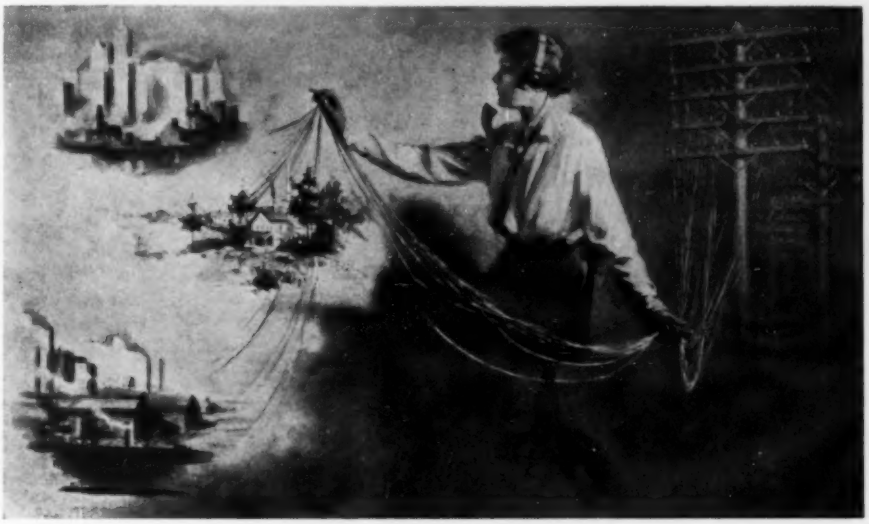
It is called "Weavers of Speech."

A line of telephone poles emerges from a shadowy mist.

The wires sweep down to the left hand of the central figure—that's you, Miss Susie!—and rise again to her right, as she feeds the lines of communication to people everywhere.

Age-old folk tales tell of Fate as a weaver, spinning the threads of destiny and weaving them into the pattern mankind must follow.

In the darkness, from which the telephone lines come to your hand,



WEAVERS OF SPEECH

". . . a picture of you was painted, back years ago before you were born"

unseen are all man's efforts to create an ideal of communication, on which he might build his future.

There are the smoke of his first signal fires, the naked runners trained to run for miles, the messengers on horseback, all of these and many more.

Progress rests on communication, and man's search for an ideal has been endless.

Into your hands come the telephone lines.

They are the fruit of his efforts and the threads of his destiny, which your hand weaves into the pattern of a better world.

It is as though you held a lantern high, and in its rays new life is forming, new growth springing up.

Where there was darkness, now there is light.

IT IS *a great picture of you, Miss Susie.*

It tells a great story—one so big mere words cannot make its import clear.

That took paint on canvas.

It is a timeless story, too, one even more true today than when the picture was painted.

That's what makes it a great picture.

And you're a great gal, Susie.

Today is a bridge over which all our yesterdays cross to make tomorrow.

You're crossing it with your chin up, eager, and alert and ready for laughter, but you're aware that these things are not all.

You carry your share of the load. And that's what makes you great!

Mr. Stephens is on the staff of the *Southern Telephone News* of the Southern Bell Telephone and Telegraph Company, and his "Memo" is reprinted from that publication.

A Subsidiary of the Western Electric Company Salvages and Reclaims Millions of Pounds of Metals and Materials Important to the Telephone Business and the Nation

Nassau—The Bell System's Conservation Specialist

William A. Scheuch

PRODIGAL USE of the nation's raw materials during four years of war has focused serious attention on declining national reserves of lead, copper, iron, zinc and many other resources vital to industry. Although our country has been drawing extensively from its natural resources for less than 100 years, there are signs of ultimate depletion within the foreseeable future. Now, as never before, industry in the United States is looking to its scrap heaps and junk piles for substance to help feed the machines of peacetime production.

Though the conservation and reclamation of used materials has been a habit of long standing in the Bell System, the careful husbanding of the by-products from manufacture and the recovery of basic raw materials from equipment retired from service throughout the System are assuming added importance.

To the Western Electric Company's subsidiary, Nassau Smelting and Refining Company, falls the major responsibility for collecting, sorting, and reclaiming the millions of pounds of scrap materials resulting from Bell System operations each year. Literally, there is gold in those piles of scrap—gold, silver, iridium, and other precious metals. But more important than precious metals to the telephone industry are the huge quantities of lead,copper, zinc, iron, steel, and aluminum. Because they resist corrosion, lead and copper are particularly important in the manufacture of telephone equipment to assure flawless performance over long periods of time. And many other products, like rubber, paper, plastics, burlap, and rope are obtained from salvaging everything from tiny switchboard lamps to worn-out trench diggers.

An aerial view of the Nassau Smelting & Refining Company at Tottenville, Staten Island, N. Y. In the background is the Kill van Kull, above which the Outerbridge Crossing stretches to New Jersey

In 1945, a comparatively low year, the Nassau organization handled 105,122,000 pounds of "Bell System" scrap. Included in this amount was enough lead to cover 1,600 miles of 1¼"-diameter cable, enough copper to produce 72,000 miles of open line wire, enough iron to build seven modern destroyers of the Bristol class, enough paper to print four and a half editions of the *New York Times*. There were 1,475,000 pounds of aluminum, 942,000 pounds of plastics, and 883,000 pounds of nickel and nickel-base alloys.

All told, the value of scrap for the year totalled $3,835,000. Contributing to this tidy sum were such divergent materials as cinders from Western Electric power plants, sold for thirty cents a cubic yard, and iridium from contact points in telephone sets and switchboards, sold at $125 an ounce.

In simplest terms, scrap is any material no longer needed in its existing form. Improved methods of manufacture, design of new equipment, and changes in tools and machinery all add to the scrap piles. In this sense, accumulation of scrap is a sign of progress.

A Nation-wide Organization

TODAY Nassau Smelting and Refining Company is a far-reaching network covering all Western Electric plants and distributing houses and closely linked with the Bell System's operating telephone companies. It's a highly coördinated team of experts including chemical engineers, metallurgists, sorters, furnace men, investigators, salesmen, market analysts and shippers to the number of 400. That so small a group can handle the disposal of so large a volume and variety of Bell System scrap speaks well for their efficient methods. Actually, almost everyone in the Bell System con-

tributes indirectly to the scrap job—even the office worker who tosses a sheet of paper into the wastebasket.

Nassau grew to its present stature from a small organization at the Western's Hawthorne plant in 1916, when for the first time a central group was charged specifically with converting the by-products of telephone manufacture into useful raw materials. Up to that time each manufacturing department had handled the scrap piles built up by the residue from busy screw machines, punch presses, and other production processes.

The wisdom of the decision to centralize scrap control became increasingly apparent as the telephone business rapidly expanded following World War I and during the boom 'twenties. The volume of scrap reclamation grew in proportion. In 1927, the newly built Kearny, N. J., plant relieved Hawthorne of handling telephone scrap originating east of Pittsburgh. The scrap piles were mounting, and so was the knowledge of how to get the most out of them. Secondary metals, as the trade calls reclaimed scrap, were becoming an important source of raw materials for the telephone business. It was time for Western Electric to shop around for a "home" for scrap, where the "know how" of reclamation was already at work.

Following a careful survey of available facilities, Western Electric purchased in 1931 the Nassau Smelting and Refining Company at Tottenville, Staten Island, N. Y., a long-established concern equipped with furnaces and facilities to handle refining on a large scale. The new Nassau company took over Kearny's scrap activities, and in addition began processing most of the non-ferrous scrap metals resulting from Western's manufacturing operations. Gradually Nassau's job grew, and in 1941 the company became responsible for disposal of all Bell System scrap.

THE NASSAU ORGANIZATION consists of two main parts: the smelting and refining plant in Tottenville, S. I.; and a special department called the Bell System By-Products Organization, which maintains representatives at each Western Electric plant and distributing house and serves as liaison with the telephone companies.

Almost in the shadow of the Outerbridge Crossing at the lower tip of Staten Island, the storage bins and railroad sidings at Nassau are bulging with bales of wire, reels of cable, boxes of assorted metal parts, all garnered from the four corners of the Bell System. These scrap products are purchased by Nassau from Western Electric and the telephone companies at prices depending on the metal content and the market value of refined metal. To balance out the company's operations, Nassau also purchases scrap materials, such as shell casings, and machine scrap of numerous varieties from other industries. During a normal year, Nassau buys about half of its secondary raw materials from the Bell System and half on the outside. Likewise, half of the metals refined by Nassau return to the Bell System for re-use in the manufacture of telephone equipment, while the remaining portion is sold to other industries in the form of bronzes, zinc dust, and other products which have limited use in telephone production.

A load of scrap telephone cable is weighed at a Western Electric Distributing House before shipment to Nassau Smelting & Refining for processing into some new form of raw materials

Classifying, Sorting, Refining

One of the secrets in reclaiming for the Bell System is careful sorting and classification. Scrap gets a preliminary "going over" at the various Western Electric factories and distributing houses. In some cases, scrap material accumulated at telephone companies is shipped directly to Nassau under the supervision of the local Nassau representative. At Western's Works locations, Nassau representatives assist in setting up efficient methods and routines to guarantee a minimum of waste. They are always on the alert to devise new methods of saving scrap at the source. They assist in setting up routines for keeping each class of waste material in separate containers—the brass in one barrel, copper in another, nickel silver in another.

The same procedure applies to retired telephone equipment dismantled at the various distributing houses. From long experience and analysis of manufacturing operations, Nassau men can estimate the quality and quantity of scrap expected from that source. Most telephone plant scrap consists of recurring items, too, like switchboard apparatus, cable, handsets, relays, and the like.

Nassau men divide anticipated accumulations into classes, based on a physical and chemical analysis of each class. First there is a general group consisting of about 14 different items —aluminum, brass, bronze, copper, iron, steel, and so on. Each of these 14 is broken down into sub-classes covering specific alloys or kinds of material. There are eleven different kinds of aluminum, for example, 17

An operator in the reclamation department of one of Western Electric's Works loads scrap metal into a baling machine. The Nassau company supervises the reclamation and disposal of all scrap material throughout the Bell System

of brass and 49 of copper scrap. In all there are about 200 different classifications covering the millions of pounds of non-ferrous scrap each year. This careful segregation increases the volume and purity of reclaimed material.

A good example of thriftiness is the salvage of cutting oils from machine lathe turnings. Sometimes those steel or brass curlicues carry oil equaling as much as one-quarter of their total weight; and to produce dry turnings and salvage the oil for re-use, turnings are passed through centrifugal separators. By this process alone, the Hawthorne plant salvages 45,000 gallons of cutting oils annually. The disposal of such by-products comes under Nassau's guidance.

After preliminary sorting at factories, distributing houses, and at telephone company locations, scrap is carefully packed, labeled and shipped. As each truck or freight car rolls into the Nassau yards, sorters start grading the scrap into classes which will best fit current demands. They can tell at a glance in what bin or barrel to throw each piece of scrap. When old metal is covered with dirt or corrosion, they may scrape the surface with a file or drill out samples for closer identification. They detect the presence of ferrous metals with a magnet. With practiced hand and eye they quickly dismantle telephone and switchboard apparatus down to the last nut and bolt.

They put lead covered cable through stripping machines. They pile jumbled wires into a baling machine and take out a compact cube

of almost solid metal which is comparatively easy to handle. In fact, when dismantlers and sorters are through with a carload of junk at Nassau, it is marked and stored, ready for the furnace operators.

THE CHIEF refining processes at Nassau—that is, "cooking" the sorted scrap in huge furnaces, kettles, and crucibles according to exact recipe, and molding it into smooth billets, ingots, solder, and wire bars—provide a colorful show. They also provide a rare lesson in conservation.

Governing all Nassau scrap operations is the endeavor to preserve the purity of the various metals as long as possible and to extract every possible use from them. The principle is the same as that of a frugal boarding-house landlady who cooks a roast for Sunday, serves cold cuts Monday, meat pie Tuesday, stew Wednesday, and hash on Thursday, with the dog finally getting the bone. Nassau scrap men, however, would salvage the bone.

Carrying along that analogy, let us say that Nassau produces a quantity of copper having the highest practical purity. From this a ringer coil for a telephone set may be made at a Western Electric factory. This coil goes into service and years later returns as scrap. The copper reclaimed from the coil will contain more impurities than originally because of the addition of soldered terminals. This product can be refined economically, however, into material suitable for manufacture of power terminals. After serving its time in this form, it can again be refined to copper metal suitable for castings, and so on down the line through the various copper-base alloys. Finally it reaches the "hash" or slag stage, when it becomes so diluted with other elements that the cost of reclamation exceeds its value. But Nassau men will still find a use for it. For instance, they might sell it to an outside purchaser for making insulation material. If the slag is not saleable, they dump it into nearby marshland owned by the company, and thereby reclaim the marshland.

The Chief Metallurgical Processes

THE CHIEF metallurgical processes at Nassau fall into three general classifications: the white metals department (tin and lead-base alloys); the red metals department (copper and copper-base alloys); and the zinc department. One of the most important jobs right now is reclaiming cable, because of the present scarcity of lead and copper. Let's take a look.

Large cables, returned to Nassau after years of service in the Bell System, go through the stripping machine which cuts the sheathing, as a knife slices through a ripe melon, and separates the lead from the paper-insulated copper wires. The very small cables go through "sweating" furnaces, where the temperature of the furnace is adjusted so that the lead will run off and the copper remain. The lead is then poured into big kettles and refined into material used for lead covering on new cable.

Some of the older type of cable has a lead-tin alloy sheath. This lead sheathing is fed into a reverbertory (oil flame) furnace, where the tin is separated from the lead. The tin-free lead is then kettle-refined, alloyed with antimony, and used for

new cable covering. The tin oxidized from this material goes into an electrical smelting furnace to be reduced to metal. This metal is refined into solder in huge 30-ton kettles. The dross or residue from the electric furnace is put into a reverbertory furnace and smelted down for use in copper-base products.

Lead cable sleeving, which Nassau makes in many sizes and of several alloys, is a prime example of long range planning for efficiency in reclaiming Bell System scrap. Knowing that each length of sleeving probably will return to Nassau at some future time after serving in the System, Nassau has long since "tagged" each piece of sleeving with a series of identifying ridges running lengthwise. These ridges tell what alloy has been used; and when at some later time the sleeving returns to Nassau, a sorter merely runs his fingers over the ridges and sorts the pieces according to the composition thus disclosed, and with a minimum of effort.

One of the most exacting processes in the red metals department is the refining of copper and the casting of wire bars. The entire operation cycle takes 24 hours to complete: eight hours for charging the furnace with a hodgepodge of metals; eight hours for refining; eight hours for casting and for preparing the furnace for the next cycle.

The refining is done in a reverbertory furnace which seems large enough to roast a full-grown moose. Certainly it's hot enough and it growls as though in a constant rage. Oil under high pressure feeds this inferno at the rate of 150 gallons each 24 hours and generates heat of over 2000 degrees Fahrenheit.

Like a chef anxiously watching his broth, an attendant wearing thick safety glasses and heavy fire-proof gloves periodically thrusts a long ladle into the molten mass and brings it out full of copper. By looking at the sample metal, the "chef" knows when it is right. To make doubly sure, however, he sends this sample

Into the furnace go these remnants of worn out telephones, and out will come brass billets

"brew" to the Nassau laboratory, where it immediately undergoes a test. If it does not meet specifications exactly, the chemist calls the furnace man by telephone and tells him what adjustment to make.

To meet Bell System standards, copper wire bars must contain a minimum of 99.93 percent copper. When this purity is assured by laboratory check, the molten metal is cast into bars weighing 250 pounds.

In the casting of composition bronze ingots, molten liquid, looking like orange juice, is poured through four spouts from an immense ladle into moulds passing beneath on a conveyor. Four moulds about the size of a bread pan proceed abreast on the conveyor. A workman tips the ladle and four golden streams fill the moulds. The ingots begin to change color immediately. After they travel a few feet, they are showered with water. In five minutes' time they change from a terrifically hot liquid into cool, solid ingots of bronze weighing 25 pounds each.

"Mining" metals from the mountains of scrap material that flow into Nassau each year is as carefully controlled as the production of primary metal. Nassau's inspectors, metallurgists, and chemists guard the quality of finished products. Nothing passes them until it meets the approved metallurgical standards. They check the scrap material before it goes into the furnaces; they control the refining operations to guarantee the proper composition of the product; and, finally, they test all finished products in accordance with the customer's specifications.

In the chemical laboratory, all kinds of devices are used to keep operations going smoothly. There are usually so many chemical operations going on simultaneously that a system of automatic timers and bells

Copper, brass, lead, and even precious metals are recovered at Nassau through the refining qualities of incandescent heat

is used. When a chemist affixes a "loaded" beaker over a burner, he sets the timer. When the desired time has elapsed, a bell rings. No guesswork here. Every minute counts. To save precious time in handling hot beakers, the laboratory uses containers made of a special glass which can be raised to terrific heat and instantly cooled by water without shattering.

Reclamation and refining operations require careful laboratory analysis. Here a chemist tests a sample in Nassau's laboratory

No Interlude from War to Peace

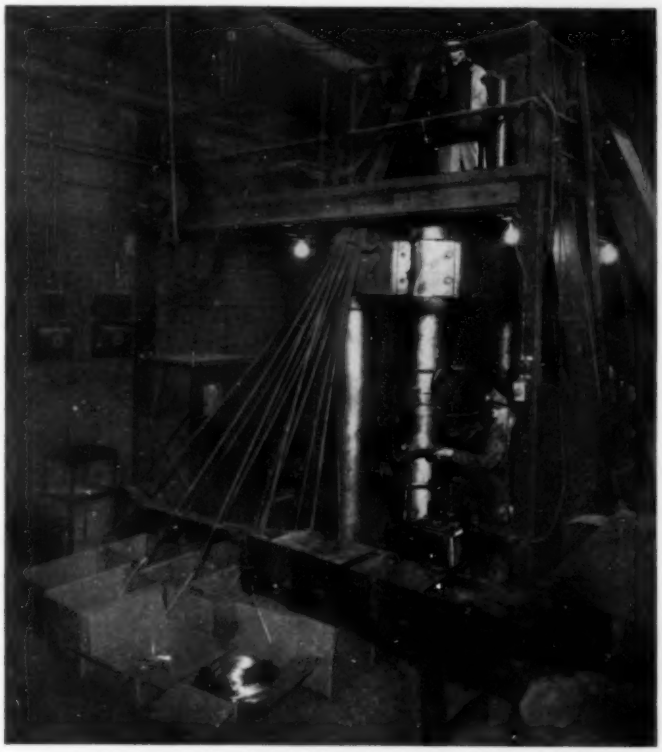
IN WAR AND PEACE Nassau is jealous of time. With hardly the loss of a stride the Nassau plant changed over from tremendous war production to the mighty task of reclaiming scrap for the Bell System expansion program. The 20-odd furnaces and dozens of kettles and crucibles are still cooking 24 hours a day, often seven days a week.

The voracious demands of war cut down the output for telephone use to a thin trickle. In 1944, Nassau supplied only 10 million pounds of "reborn" metal to the Bell System (as against 75 million pounds to foundries for war production) or about 12 percent of the total output. Before the war, Nassau had supplied an average of 50 to 60 percent of its total production to the System.

As soon as victory was assured, Nassau began repairing, overhauling, and reconverting furnaces to whip up production of staple telephone raw materials like lead, solder, copper wire bars, and ingots. The output for the Bell System began to climb. At the end of the first two months of 1946, Nassau had supplied 2,448,000 pounds of finished material for telephone manufacture, or about 33 percent of its total output. At the end of the seventh month the output for Bell System account had jumped to 47 percent: 19 million pounds of processed metals out of a total of 40,627,000. And week by week production for the System continues to climb.

The By-Products Organization

NATURAL BY-PRODUCTS of Bell System operations from coast to coast



A dozen streams of wire solder pour from the pipes of this solder press at the Nassau plant and coil neatly into containers

include a long list of substances, from pinpoints of precious metals to locomotives from the Manufacturer's Junction Railway which serves Western's Hawthorne Works. The list includes rubber, plastics in a hundred forms, all sorts of paper, typewriters, automobiles, cinders, and most other materials which the Bell System uses and discards in the course of its daily operations.

The disposal of this varied and miscellaneous scrap is the job of Nassau's by-products organization. The work of the by-products men is highly technical, involving a detailed knowledge of materials, markets, shipping, and scientific processes of reclamation. They work on the principle that there must be some use or purchaser for any scrap item, no matter how low it falls in the scale of market values.

All replaced equipment in the factories of Western Electric or in telephone exchanges is not necessarily scrap. A machine which is replaced in one department may be serviceable in another part of the plant. Nassau's representatives take over the disposal of all equipment and machinery not usable by the Bell System.

The field representatives of the by-products group serve as advance scouts and liaison men. They supervise the collecting, classifying and disposal of scrap in local areas. They watch local markets and report new developments to headquarters. They work closely with the scrap agents of the Bell telephone companies in terms of the supply contracts which Western Electric maintains with each company.

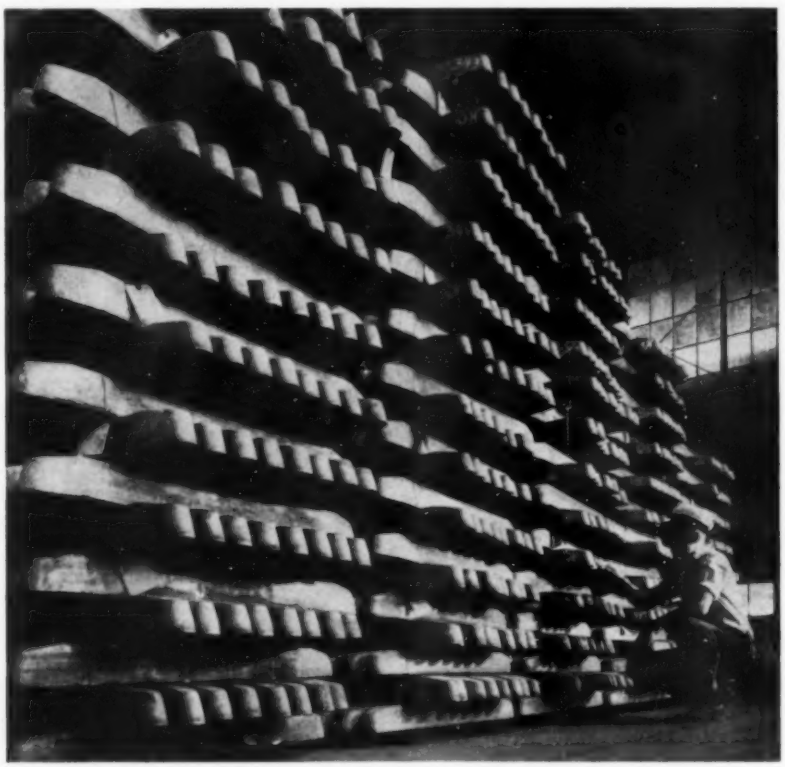
In the course of a day's business, one by-products man may arrange for the sale of impregnating compounds (composed of paraffin and beeswax) to a processor for making industrial waxes. Another may find a purchaser for scrap fibre shearing, to be made into necktie pressers, insulators, washers, or toy parts. Still an-

other may be selling cork shavings to be processed into insulating material. Old telephone booths are in great demand for manufacture into high grade picture frames.

In disposing of cast-off material, by-products men first try to find purchasers within the Bell System. If there are no bids from the System, they find outside purchasers. This method of procedure sounds simple enough. The execution of it, however, demands highly specialized knowledge and resourcefulness.

Toward Maximum Use

As THE BELL SYSTEM'S team of experts in conservation, Nassau sees a continuing and increasing challenge in the days ahead. To them the depletion of our nation's mineral resources places new emphasis on the necessity for efficient salvage procedure. They see themselves as an element in the national program to conserve the materials so vital to our economy. More specifically, the men and women at Nassau recognize their responsibility in speeding "reborn" raw materials into telephone production. Nassau is constantly devising new techniques and improving methods for extracting the last bit of value from Bell System scrap and for channeling urgently needed metals back into service in the shortest time and with a minimum of loss.



Reclaimed, refined, and molded into wire bars, copper by the ton at Nassau awaits shipment to Western Electric, where it will be drawn into copper wire

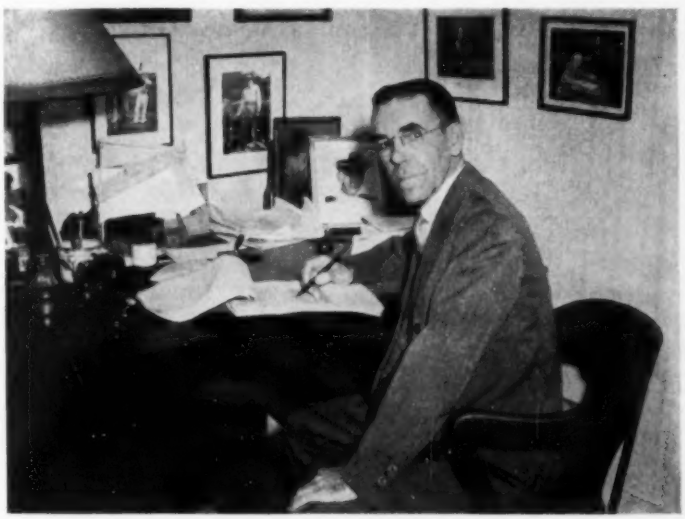
Commercial Broadcasting Pioneer: The WEAF Experiment, 1922-1926

A Book Review

WEAF IS NO MORE. The call letters which for nearly a quarter of a century designated a radio broadcasting station famous for its pioneering achievements ceased last November to have meaning. WNBC is the name now. But even as the old name goes down into history, we have today an excellent record of the years when the station was the experimental radio broadcasting medium of the American Telephone and Telegraph Company.

This is the newly published "Commercial Broadcasting Pioneer: the WEAF Experiment, 1922–1926," by William Peck Banning. In this fine work of research and interpretation, the author has not only set forth the facts about the A. T. and T. Company's creation and operation of WEAF, but he has so displayed them against the contemporary scene that their social and economic as well as their technical importance becomes clear.

The author, as many who will read the book already know, was a member of the A. T. & T. Company Information Department for 24 years, and for 17 of those years before his retirement in 1944 he served as an assistant vice president. He was a keen observer of many of the events he describes and was acquainted with many of the principal figures concerned in the rapidly expanding enterprise. Personal recol-



William P. Banning at work on the manuscript of "The WEAF Experiment" at his home shortly after his retirement from the A. T. & T. Company in 1944

lection thus aided the exhaustive inquiry which makes the book an authoritative document.

It is Mr. Banning's conclusion that the A. T. & T. Company's four-year experiment with WEAF aided the development of radio broadcasting in three unique, constructive, and important ways.

The first of these, he believes, was in the scientific and technological field. Basic contributions here were to be expected from an organization which had transmitted one-way speech through the ether to Paris and Honolulu as early as 1915. Among them was the establishment of network broadcasting.

The second, the author feels, was the emphasis on a high standard of radio programs.

The third was the determination of the means whereby radio broadcasting could support itself: "toll broadcasting," as it was first termed. This concept of making broadcasting facilities available by selling time on the air was the contribution of A. T. & T. President Walter S. Gifford—then executive vice president—and set the pattern for broadcasting as we know it today.

"The experiment was continued . . . until its animating idea had been proved," says Mr. Banning in his *Author's Preface*. "When it was over, and Station WEAF passed to new ownership, public hospitality to broadcasts of every type had been tested, network broadcasting had been established, and the economic basis upon which nationwide broadcasting now rests had been founded. A trail had been blazed that thereafter could be followed without hesitation. A self-imposed service of investigation had answered the question, 'Quo vadis, radio?' "

Mr. Banning has avowedly written "for the record" and in order that telephone people throughout the Bell System may have access to a significant chapter of communications history—a chapter which is little known to a younger generation while it fades from the memory of those who knew of or participated in events as they happened. His book will be of special interest to all who had any connection, direct or indirect, with the creation and early operation of WEAF; to others who want to know or to be reminded of how radio got to be what it now is; and perhaps to yet others who have a nostalgic fondness for the days when radio was a new magic and commercials were not jingled.

Mr. Banning's book includes the era during which WEAF first brought to millions of delighted listeners such radio favorites as Graham McNamee, Roxy and his Capital Theatre gang, Billy Jones and Ernie Hare—the Happiness Boys, the A. & P. Gypsies, the dance music from the Rose Room of the Waldorf, and many another. It ends with the sale of WEAF in 1926—the logical sequel to the A. T. & T. Company's conclusion that radio broadcasting was a one-way service in the entertainment field and therefore not compatible with its principal business of furnishing the nation with two-way communications service.

J. S. B.

Commercial Broadcasting Pioneer: The WEAF Experiment, 1922–1926. William P. Banning. The Harvard University Press: Publication of the Business Historical Society. xxxiv + 294 pages + index. 6 charts, 2 tables, 30 illustrations. $3.50.